APRIL, 1937

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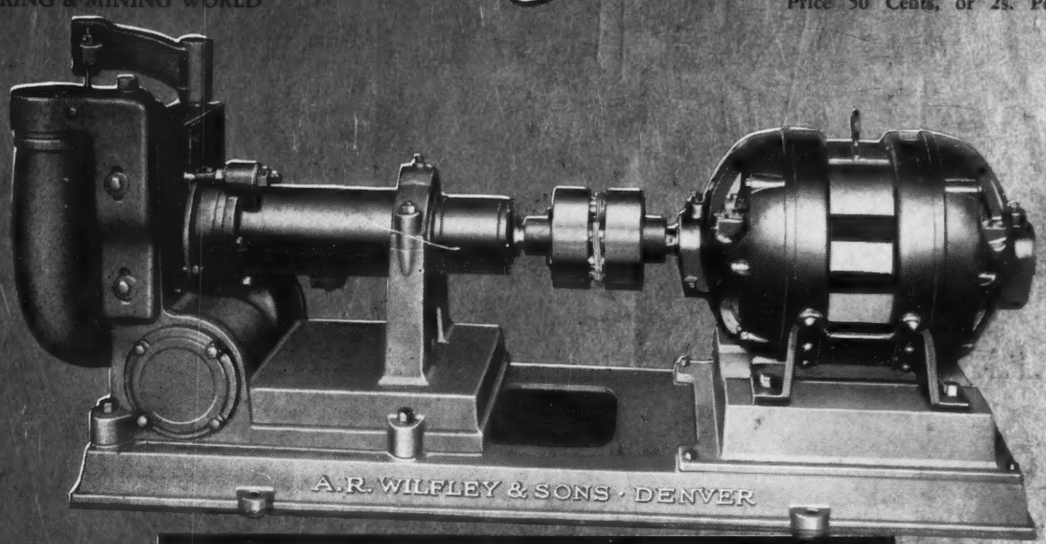

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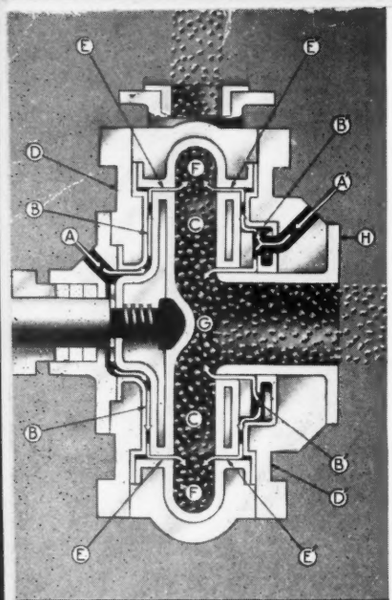

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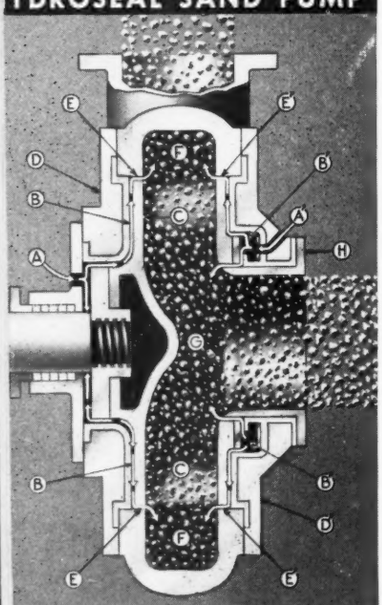

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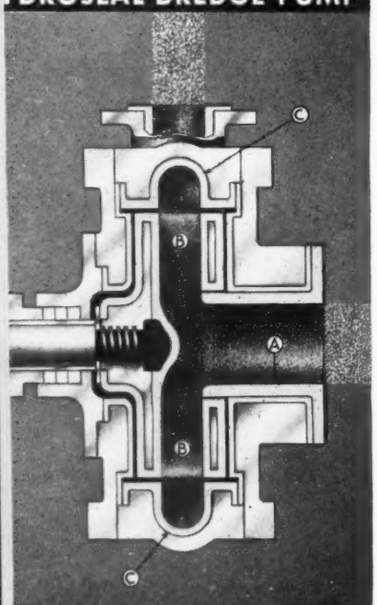

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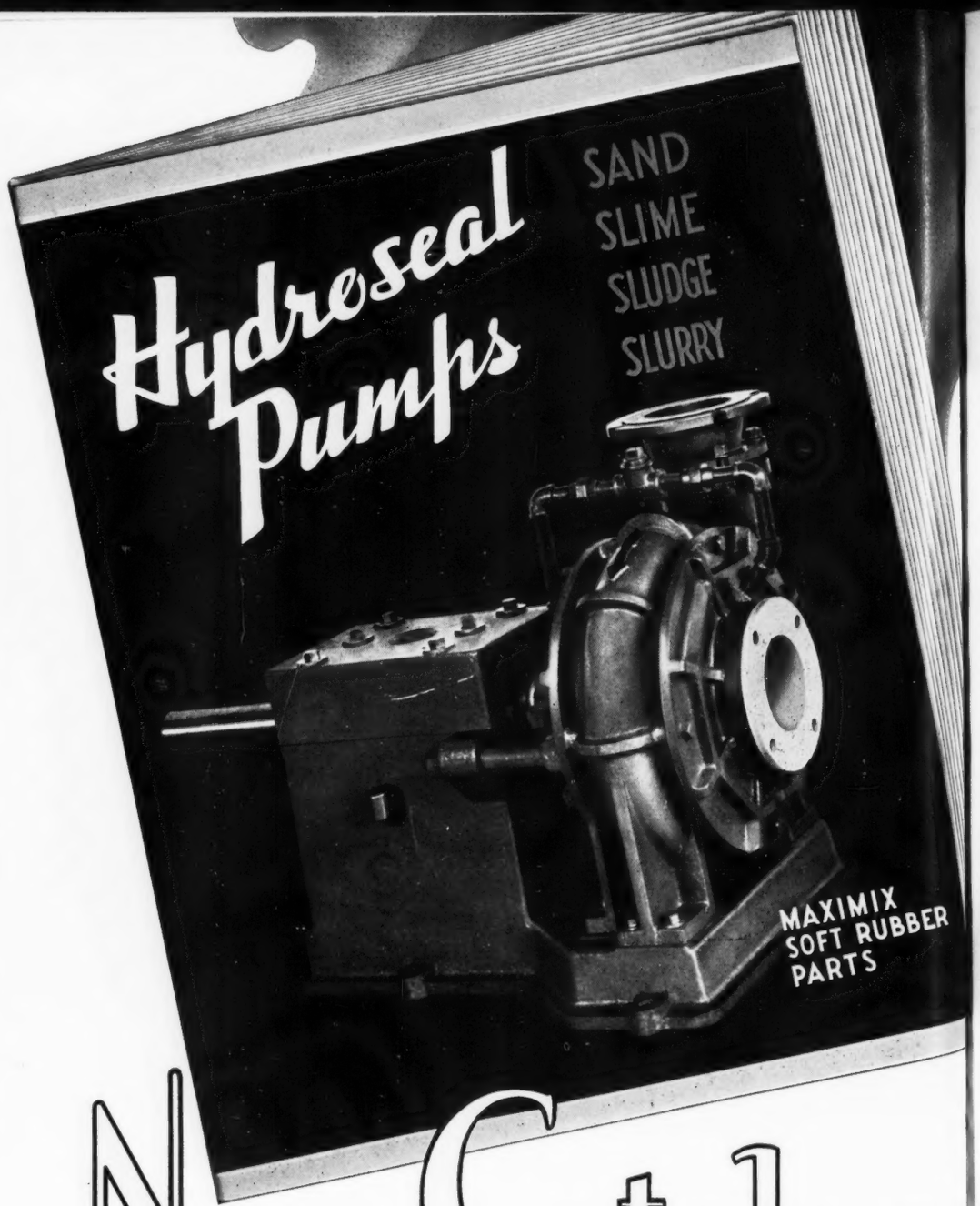

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Shrinkage stoping has been standard practice at the Patiño tin property, in Bolivia, since 1924, at which time it replaced an underhand mining method. Experiments have recently been made with cut-and-fill stoping in areas where ground is weak or sorting might be advantageous. The mining practice will be described in detail in the May issue by Messrs. Deringer and Payne.

▼

Alloy irons and steels are finding constantly increasing application in mine and mill equipment, as is known throughout the industry. Many readers, however, lack precise information as to the way these materials are employed and the reasons for choosing specific alloys for given purposes. Useful data on the subject will be presented in the May number for the benefit of those who may be interested.

▼

Trends in underground loading are discernible only after detailed and widespread study. Facts recently obtained by means of a survey made by Bureau of Mines economists and engineers will be published in an early issue.

▼

Secret Process. A St. Louis paper reports that "a wealthy raincoat manufacturer" has organized a company to exploit a secret chemical process to extract gold from the tailings piles in the Missouri lead belt. The gentleman should set aside at least one raincoat for personal use after he loses his shirt in the venture.

▼

And British Gold! Professor Emerich Herzog has arrived in Wales, where he believes there is more gold than ever came out of the Klondike. At last accounts, with a silver divining rod he was about to climb Moel Slabod, on which he found evidence of the metal 30 years ago. But perhaps erosion or transmutation has been under way in the meantime. Some months ago a company was formed to develop a reef in North Wales, which a letter written long before had said contained high values. A mere trace was found, whereupon the company apologized and presumably has sold its drill and hammer second-hand.

▼

Lovers of horse flesh were thrilled no doubt when one "Copper Tube" made an excellent showing at the race track. This naturally caught the eye of the Copper & Brass Association's publicity man, who gave it prompt attention. And he does not stop there but seeks to capitalize the bronze horses of St. Marks, also one Paul Revere, well-known equestrian and pioneer copper products manufacturer, as well as Pocahontas, the Indian princess who, by bribing a kinsman with a copper kettle, put herself on a British ship and thereby on the road to fortunate marriage. All of which emphasizes the outstanding merits of copper and incidentally recalls that speculators recently showed that the "red metal" was good for a ride.

▼

Radioactivity from ore deposits is quite incapable of affecting electromagnetic beams used for the direction of airplanes in flight. Recent mysterious air-transport accidents in California are not to be explained by assuming that neighboring ore deposits caused distortion of direction beams, and thus misled the pilots. The two phenomena have quite different characteristics.

H. C. PARMELEE
Editorial Director

Engineering and Mining Journal

A. W. FISHER
Manager

Published by McGraw-Hill Publishing Co., Inc.
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Published monthly. Subscription rates, United States and Canada, $3 per annum; other countries in the Americas outside the United States and Canada, $4 per annum; elsewhere $5 or 20 shillings per annum. Price per copy, 50c or 2s. Application for entry as second-class matter at Albany, N. Y., pending. Printed in U. S. A.

McGRAW-HILL PUBLISHING COMPANY, INC.
Publication Office, 99-129 North Broadway, Albany, N. Y.
Editorial and Business Offices, 300 W. 42d St., New York, N. Y.
Cable Address: McGraw-Hill, N. Y.
San Francisco: 883 Mission Street
Chicago: 520 North Michigan Avenue
Washington, D. C.: National Press Building

McGRAW-HILL PUBLISHING COMPANY, LTD.
Aldwych House, Aldwych,
London, W.C.2, England
Cable Address: Backlash, Estrand, London

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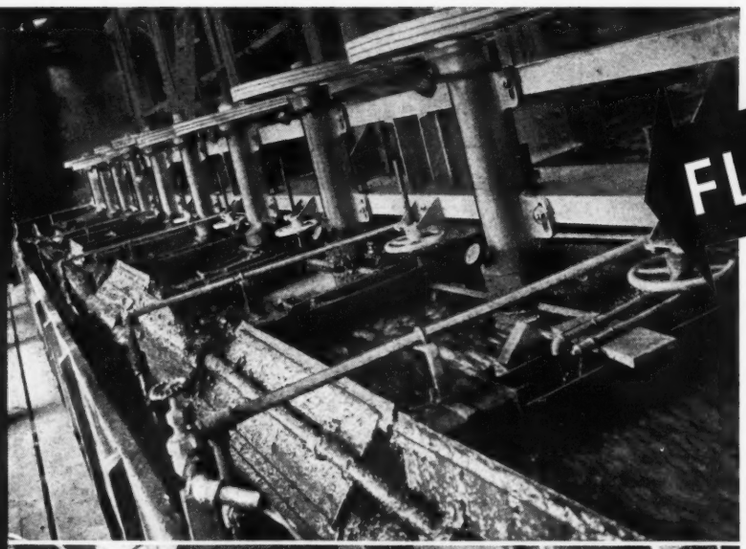

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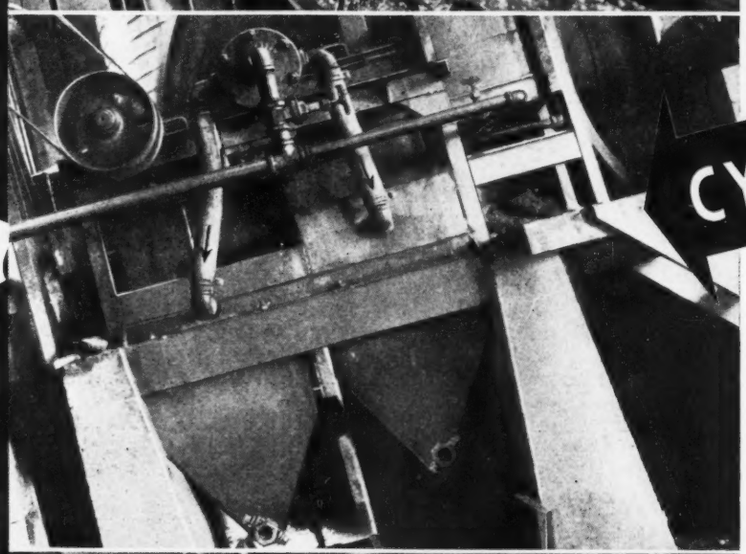

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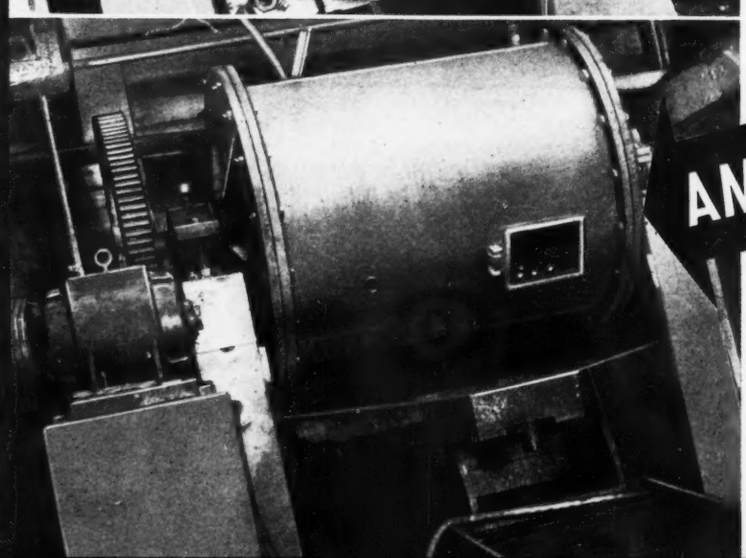

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Volume 138 Number 4

APRIL 1937

Metal Prices Under Fire

REMINISCENT of the "vaulting ambition that o'erleaps itself," the job of economic recovery is apparently being overdone in some directions. At least that seems to be what's happening in the rising spiral of commodity prices. The sequence of events runs something like this: First, a world still suffering from a depression complex fails to realize how far recovery has progressed. Second, suddenly confronted with an extraordinary demand for raw materials, it discovers a temporary shortage in stocks. Third, speculation and fear aggravate the condition, and prices rise beyond reasonable levels. The inevitable fourth step is a correction, evidence of which has already appeared in the major metal markets. The reaction is a healthy one.

The President, in his extraordinary pronouncement on commodity prices on April 2, singled out copper and steel as offenders in price. In the first 90 days of 1937 copper rose from 12c. to 17c. per pound, as compared with a rise from 9¼c. to 12c. throughout 1936. True, domestic producers were swept along on the wave of speculation originating in London, but the last price increase was made in the face of indications of a reaction abroad. Hence the target was too bright for the New Deal to miss.

But in his general deprecation of the speed of recovery of the durable goods industries the President cannot lightly dismiss the Government's responsibility by declaring what is, in effect, a buyers' strike on industrial goods. Was not recovery in the durable goods industries one of the goals of the Administration? Did it not desire and stimulate higher prices under NRA? Did it not "prime the pump" for years with billions? Has it not laid the foundation for inflation by its gold and silver policies? And has it not greatly increased industrial costs by extraordinary taxation and its attitude toward labor? In the face of these policies, many of them of questionable economic soundness, is it now consistent for the President to try arbitrarily to shift the course of recovery from durable to consumer goods? The Government has too much responsibility for past events to pillory the durable goods industries at this time. Nor is it giving any evidence of changing its own inflationary policies.

All this, however, grants no immunity to the producers of raw materials from exercising a measure of control over prices. This is an industrial country. Its prosperity lies in the widest possible distribution of manufactured goods at the lowest possible cost. The immediate need is for increased production and wider distribution. Unreasonably high prices for metals and other raw materials will only postpone or defeat this desirable end. Hence the need for moderation and sound economic justification in raising commodity prices.

Consumers can help by controlling their fear of a metal famine and still higher prices. Producers are rapidly remedying the temporary shortage, and ample supplies are in sight. There is, therefore, every reason to believe that the normal working of economic forces will bring about a correction of abnormal prices. Meantime the durable goods industries should continue to expand production despite the President's strictures. And the mining industry should manage its own operations so efficiently and economically as to make metals freely available to manufacturers at the lowest possible price. By such means recovery will proceed without violent fluctuations.

That Manganese Stockpile

OUT of the long-protracted argument over the advisability of the manganese tariff, viewed as a means to industrial preparedness for both war and peace, has come admission by both sides that provision by the Federal Government of a stockpile of metallurgical ore as a reserve above ground would be wise, at least until a domestic industry of dependable size has been developed. The question why the industry in this country has not

grown in its production, despite long protection, still affords chance for a not one-sided debate, which it is unnecessary at the moment to revive. Respecting a stockpile reserve, however, action has lagged, and it is high time that something were done. Sudden cessation of the country's manganese supply from abroad would unquestionably present a dangerous situation. So the proposed bill now pending in Congress to spend some money in this direction, discussed on page 206 by our Washington correspondent, merits serious consideration.

A secondary question also arises: Shall this reserve be built of domestic or foreign ore? Naturally, domestic interests would like to get as much of the business as possible, having had so little luck with those who might be looked upon as their logical customers and whose opposition perhaps has not always been due to market reasons. Preparedness is the paramount consideration. But the possibility of obtaining domestic ore of suitable grade should not be ignored. Any assistance the industry has been getting from the existing tariff has been diminished, indirectly though it be, by the reciprocal trade agreement with Brazil in its provision respecting manganese.

To Speed Patent Appeals

ANY PLAN which promises "fewer jumps to justice" deserves consideration. The proposed single Court of Patent Appeals probably qualifies for studious attention, because it may give American industry and American inventors a better chance to get quick action in the final settlement of patent litigation. The mining industry will want to support this effort. Whether it will wish to support the McAdoo Bill, S. 475, now before the Senate Committee on Patents, is not so clear. That bill does afford the unquestioned advance of simplifying patent appeals. But it complicates that good proposal with many other features, some of less than doubtful value.

Mining engineers and other technical men will look with particular doubt on the proposal that the new Court, when established, should have three scientific advisers whose aid would be presumed to prevent technical or scientific error on the part of the jurists. Anyone acquainted with the complexity of modern industry knows how difficult it is to find a specialist thoroughly conversant with a small area of modern science and technology. There is grave doubt, therefore, whether an appellate court could possibly find three advisers whose experience and knowledge would suffice to advise the court usefully on *all* kinds of patent matters.

The mining industry would be well served by a more prompt decision in the final stages of patent controversy, but promptness should not be achieved at the sacrifice of justice or dependability of the courts. It is likely, therefore, that mining engineers generally will wish to support the single-court idea only if it can be detached from this complicating matter of a very limited number of advisers who would work with the jurists under great disadvantage both to themselves and to litigants. The reasons for the dangers involved, already described in the language of critics in recent news pages, are so obvious that no new appellate court might be preferred to one so encumbered.

Federal Loans to Mining

EXTENSION of financial aid to "small miners" in Mexico is now being considered by that country's Federal Administration. This causes no surprise, for, on the one hand, it must indeed be difficult for the owner of mining property there to secure new financing today, and, on the other, the example has already been set in the United States in the policy whereby the Reconstruction Finance Corporation can make loans to the mining industry here in approved cases and under stated conditions. The Secretariat of National Economy in Mexico City is doubtless aware that those who have sought loans here from the RFC have thought the Corporation strict in its terms and regulations; and that the Corporation, on its part, has found such strictness needful to avoid waste of money and the abuse that might otherwise occur if a liberal course were taken. Indeed, the total amount of loans authorized by the RFC to the end of 1936 has been small—a little less than $10,000,000, of which the applications for approximately one-fourth were subsequently withdrawn or cancelled and only $1,872,500 was actually disbursed. Of the latter sum $495,000 has been repaid. As for the loans authorized but not made use of, one may find perhaps a partial explanation in the fact that after such authorization has been made, the would-be borrower is advised as to the conditions under which the money will be released to him, and he is free to accept or decline.

The figures given speak for themselves. The Reconstruction Finance Corporation has been wisely conservative, so far as mining loans are concerned. At the same time, the availability of this source of borrowing has doubtless made it easier for worthy projects to secure money from private sources.

PATIÑO

Leading Producer of Tin

THE LLALLAGUA DISTRICT from the top of Salvadora Mountain. The three towns of Siglo XX, Llallagua, and Catavi can be seen

I . . . The Ore Deposits of Llallagua

D. C. Deringer . . . and . . . John Payne, Jr.
Mill Superintendent *Chief Geologist*
Patiño Mines & Enterprises Consolidated, Inc.
Llallagua, Bolivia

▶ **Pre-eminent** as the world's largest individual producer of tin, Patiño Mines & Enterprises Consolidated, Inc., which operates in the Llallagua district of Bolivia, is also the premier lode-mining enterprise of the tin world. Its principal property is near the towns of Llallagua[1] and Uncia, in the Province of Bustillo, about 75 miles southeast of Oruro, and on the eastern watershed of the eastern range, or Cordillera Real, of the Andes. Here the elevation above sea level is 12,000 ft. at the millsite and 15,000 ft. at the topmost mine workings. The climate, despite this altitude, is reported to be agreeable and mild.

▶ **The Cordillera Real** constitutes one of the world's greatest reliefs and includes many of the highest peaks in South America. Some of these reach an altitude of over 21,000 ft. Between it and the Cordillera Occidental, 90 miles to the west, lies Bolivia's *altiplano*, the high plateau, at 12,000-ft. elevation.

▶ **It is along the Cordillera Real** that the country's great mineralized belt occurs, extending from the Argentine border on the south to Lake Titicaca on the north. This mineralized zone is characterized by the occurrence of numerous metals but particularly by tin and silver. The major tin mineralization of the district is in Llallagua mountain. The Llallagua mine has the most important deposit in Bolivia and is situated roughly in the center of this metalliferous belt.

▶ **The mining camp** of the district is known as Siglo XX (or Siglo Veinte, meaning "Twentieth Century"). The administration and mill camp is at Catavi and the local government at Uncia. From the last-named point a company-owned railroad runs to the main line of the Antofagasta-Bolivia railroad, meeting it at Machacamarca, 15 miles south of Oruro. Over this road pass all incoming freight and outgoing concentrates.

▶ **In this and subsequent issues,** Messrs. Deringer and Payne present a picture of the Patiño company's property and operations. The current installment gives a brief but adequate description of the Llallagua ore deposits and the procedure followed in sampling them—a fitting preliminary to the accounts of the mining, milling, and power-production operations that will be published in the issues of May, June, and July, respectively.

THE tin deposits of Llallagua[1] consist of a complex system of veins within and contiguous to the Salvadora stock, which is a highly altered quartz rhyolite or latite porphyry of volcanic origin. This stock is elliptical in shape, measures roughly 1,600 by 1,000 meters at the surface, though less in depth; and the major axis strikes northwesterly. Contact between the intrusive and the sediments is very irregular. The stock intrudes a sedimentary series, probably of Paleozoic age, consisting of a black, sericitic graywacke at the base,

[1] For additional description of the geology of the Llallagua mine, see: Turneaure, F. S.: "The Tin Deposits of Llallagua, Bolivia." *Econ. Geol.*, Vol. 30, pp. 14-60, pp. 170-190, 1935.

followed by interbedded sandstones and shales. The sediments are regionally folded into a series of anticlines and synclines, the stock cutting an anticline the axis of which strikes northwesterly. On the east the intrusive is bordered by the graywacke and on the west by a blue-black slightly micaceous shale.

The porphyry has been highly altered, its principal constituents now being sericite, tourmaline, and primary and secondary quartz. In some cases, the feldspar crystals retain their original form but are composed of secondary minerals. Alteration of the rock mass was complete. Over large areas of the intrusive there is brecciation, the rhyolite forming a groundmass containing fragments of sedimentary material, ranging from minute particles to angular fragments an inch or more in size. From the point of view of vein formation and mineralogy, the pure porphyry and the porphyry breccia are the same. The abundance of breccia, the absence of chilled contacts, and the inverted cone shape of the vent indicate the volcanic origin of the intrusive.

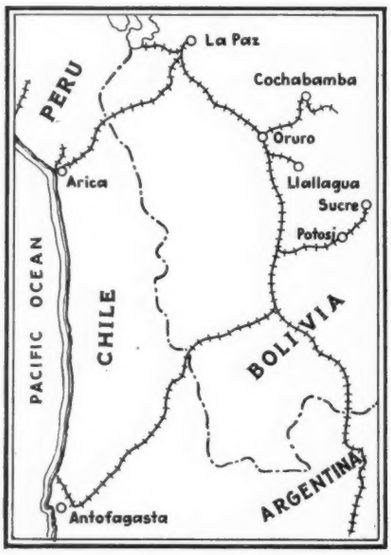


Fig. 1 . . . LLALLAGUA, in Bolivia, is on the eastern watershed of the Andes, about 75 miles southeast of Oruro

An interesting feature is the clastic bodies found within the intrusive. These bodies occur in dike-like form or irregular masses and are composed of both igneous and sedimentary material. They were probably formed during the time of igneous action (1) by grinding and adjusting which formed a homogeneous product that was forced upward as volcanic mud, or (2) by material which filtered in from above. That they were usually formed before mineralization is proved by the fact that some are offset by the veins.

An intimate relationship exists between the tin veins and the porphyry stock, and, with the exception of the Contacto vein, the deposits of economic importance are almost entirely confined to the porphyry. Pre-mineral fracturing is the controlling factor in ore deposition. The fracturing is of regional scope because some of the vein fractures extend beyond the porphyry boundary. The surrounding sedimentary rocks were, however, less susceptible to fracturing, and the ore deposition was so closely related to the intrusive that the margin of ore is broadly defined by the periphery of the intrusive. The complexity of the vein system is shown by the fact that there are 46 main veins and almost 1,000 branches, all of economic importance.

Hydrothermal alteration of the vein walls is rare. In places tourmalinization of the vein walls has been noted by what is locally called "black porphyry." Actually, this altered rock is tourmalinized quartz porphyry, and usually the alteration does not penetrate for more than a few inches to a foot. There are larger areas, however, where the quartz porphyry shows tourmalinization. As a rule the wall rock does not contain cassiterite, and where the adjoining rock does carry values, the ore occurs as minute fissure filling rather than wall-rock replacement.

There are two types of veins: shear veins and tension veins. These are closely related and are the result of the same dynamic activity. The shear veins are characterized by flat dip, 55 to 75 deg., gouge in the vein filling, and slickenside walls. These fractures are slip faults produced by shearing as a result of relief of stress in conjunction with the forces of volcanic activity and by stresses within the intrusive as it adjusted itself during cooling. Veins of this type form the bonanza lodes which comprise the main veins and many of the branches. Frequently, due to narrowing or clay filling of the structure, veins of this class may be low grade for a distance. However, when the fracture widens or the clay filling is replaced by mineralization, extremely good values may reappear; and for this reason shear veins may be followed persistently in development, and may be projected for distances of from 30 to 60 meters with assurance that the structure will continue.

The tension veins are noted for steep dip, 80 to 90 deg., and have no gouge filling or other fault characteristics. This type was formed by tensional stresses during the cooling of the igneous rock. These veins are nonpersistent and usually extend for only a relatively short distance before the structure loses its values, feathers out, or disappears entirely. *En echelon* arrangement is a common feature of this type, but is not encountered in the shear veins. Individual veins of this type cannot be projected with confidence, but in some areas parallel structures are found close enough together to form a group which may be projected to the adjacent level, 30 meters. Fracturing was not sufficiently intensive to produce the typical stockwork pattern, but there are places where these groups of tension veins are close enough together to be mined as a unit. The more typical example is that where each vein forms a separate stope.

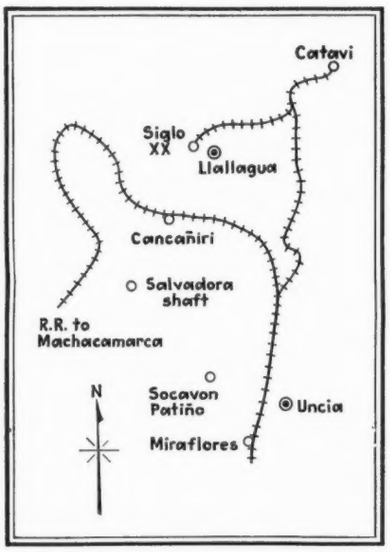


Fig. 2 . . . PRINCIPAL TOWNS and points of major interest in the Llallagua district, in the Province of Bustillo

These tension veins form lateral connecting structures between the stronger shear veins, individual fractures which are independent of other veins, and vertical splits from the strong veins, the last named being particularly important in some areas. The relation of these hanging-wall splits to the shear veins can best be seen in vertical section (Fig. 4).

If taken over an appreciable distance, the veins show a marked consistency in striking from N. 10 deg. E. to N. 40 deg. E. However, in veins of the shear type, abrupt changes occur in strike, but this abnormal condition extends for only a short distance before the characteristic direction reasserts itself. These segments of unusual strike may carry only barren clay and are a part of the pattern of pre-mineral fracturing.

A third type of mineralization which has become of great importance in recent years is what is locally known as "brecciated ore." This ore is found on the southeast contact between the intrusive and the sandstones. At the time of volcanic action, large blocks of

sandstone were torn from the periphery of the vent and entered the magma. This sandstone was quickly metamorphosed to quartzite, and, being brittle, was highly fractured. The mineralizing solutions, as they were carried upward through the channelways that now form the strong veins, invaded the minute fractures and mineralized the quartzite, not in the form of individual veins but as masses consisting of the fragmented rock cemented by cassiterite-bearing material. These areas are irregularly shaped and cannot be projected with any confidence, but when encountered they form stopes of large tonnage and reasonably good grade. Lately the study of this type of mineralization has been intensively carried on, and the areas which appear favorable are being explored thoroughly. Further study may reveal additional information concerning this class of mineralization.

Although the ore-bearing mineral is cassiterite, SnO_2, there is an abundance of other minerals, some of which are unusual. The cassiterite occurs in two ways: (1) as fine-grained, black bands or masses which are more easily distinguishable by the hardness and specific gravity than by the crystalline form, and (2) as small, brown to black crystals found in the vein walls or in crusts and cavities in the vein filling. The usual vein structure is a band of quartz bordering the porphyry wall, followed by a band of cassiterite which in places overlaps the quartz band, the central part of the fracture having a pyrite filling which may contain cassiterite. Briefly, there is usually a distinct banding in the vein structure, but the bands may penetrate each other and one or more of the minerals may be absent. Many examples are offered where cassiterite is adjacent to the wall rock, with pyrite in the vein center, or entirely absent; and other cases of veins composed entirely of quartz and cassiterite.

Pyrite, marcasite, and quartz are the three most important gangue minerals, but the vein filling may contain the following accessory minerals: bismuthinite, sphalerite, arsenopyrite, vivianite, wavellite, stannite, siderite, pyrrhotite, frankeite and wolframite. Rare minerals are: native bismuth, greenockite, tetradymite, chalcopyrite, muscovite, covellite, and tetrahedrite. The vauxite minerals, of which Llallagua is the type locality, occur in some areas.

The veins are of exceptionally high grade, some assaying from 50 to 65 per cent, but the widths are usually narrow, which entails dilution due to necessary overbreak in stoping. Some of the bonanza lodes, among the richest tin veins ever mined, are as much as 3 meters wide, but the average width of the veins being mined today varies from 3 to 15 cm. Inasmuch as the minimum practical stoping width is about 80 cm., the waste dilution may be great.

Veins in the oxide zone exhibit unaltered, crystalline cassiterite. Cassiterite is not attacked by acid waters; therefore the small amount of tin found in the mine water is probably due to dissolving of stannite or frankeite, both of which are found in small quantities in some veins. Many outcrops show ore of paying grade, and a few of the stopes have been mined to the surface.

Depth of oxidation is extremely irregular, varying from only a few meters in some veins to 200 meters in

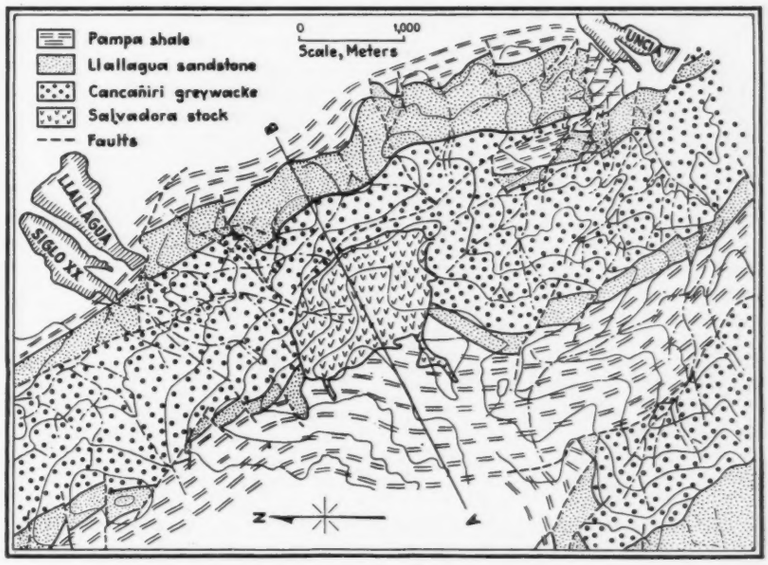


Fig. 3 . . . AREAL GEOLOGY of the Llallagua region surrounding the Salvadora porphyry stock. An area of 35 sq. km. is shown, lying chiefly along the major anticline intruded by the porphyry

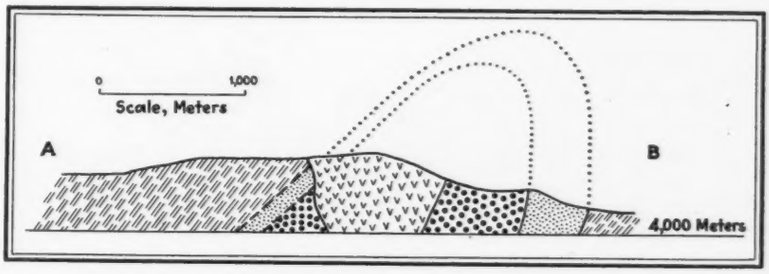


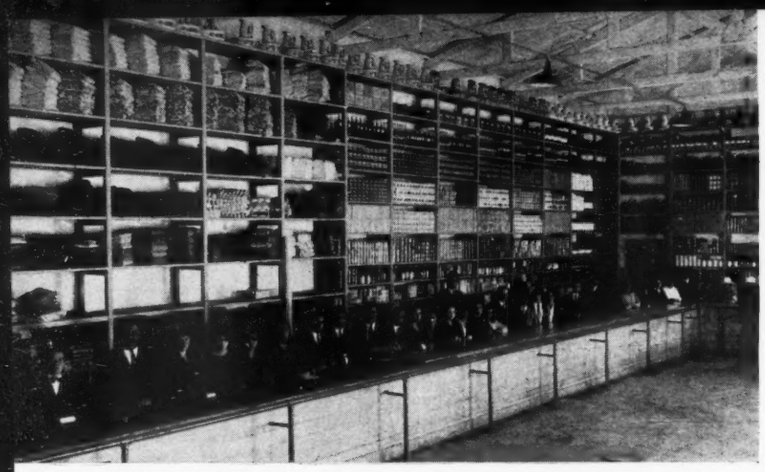
Fig. 3A . . . A SECTION taken along the line A-B in Fig. 3

others. The variation in depth of penetration is due to different conditions of weathering and to porosity and susceptibility of the particular vein to the oxidizing solutions. In certain localities a marked enrichment takes place in veins a short distance, 10 to 50 meters, from the surface. This enrichment is both mechanical and chemical, and it is due to meteoric waters percolating downward through the fracture, oxidizing the pyrite, and leaving the cassiterite, which is carried for a short distance before it settles again, and forms extremely rich zones of limited vertical range.

Both post-mineral and pre-mineral faulting occurs. There are three major post-mineral fault planes: the Stanton, Diaz, and Transformador. Beside these major movements numerous smaller faults are found whose displacements usually offer little difficulty to geological interpretation.

Solution of these important fault problems has contributed greatly to the value of geologic mapping, and one of the major problems for the geologist is the continued study of the fault data. Exploration now in progress may discover the faulted segments of some of the major veins, which would add appreciably to the ore reserves as well as render valuable information for the guidance of the future development work.

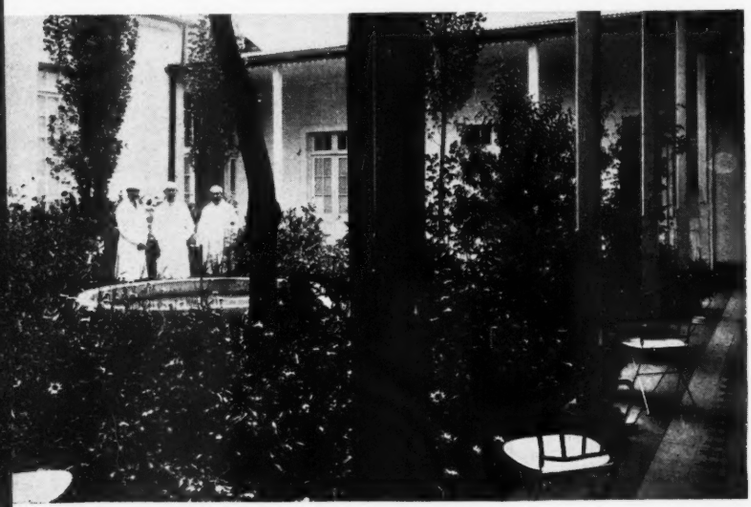
In occurrence, the tin deposits of Llallagua are fissure fillings of near-surface, high-temperature, hypogene origin. The ore was formed by hot, ascending solutions circulating upward through channelways in the igneous rock. Both the mineralizing solutions and the porphyry stock probably originated from some parent igneous body which crystallized in depth. To understand the ore occurrence at Llallagua the conditons of volcanic action caus-



IN THE COMPANY STORE at Catavi. An effort is made to stock this and others like it with all table necessities, imported and domestic. Fruits and vegetables are available in season

In the Llallagua District

GLIMPSES OF THE PATIÑO ENTERPRISE



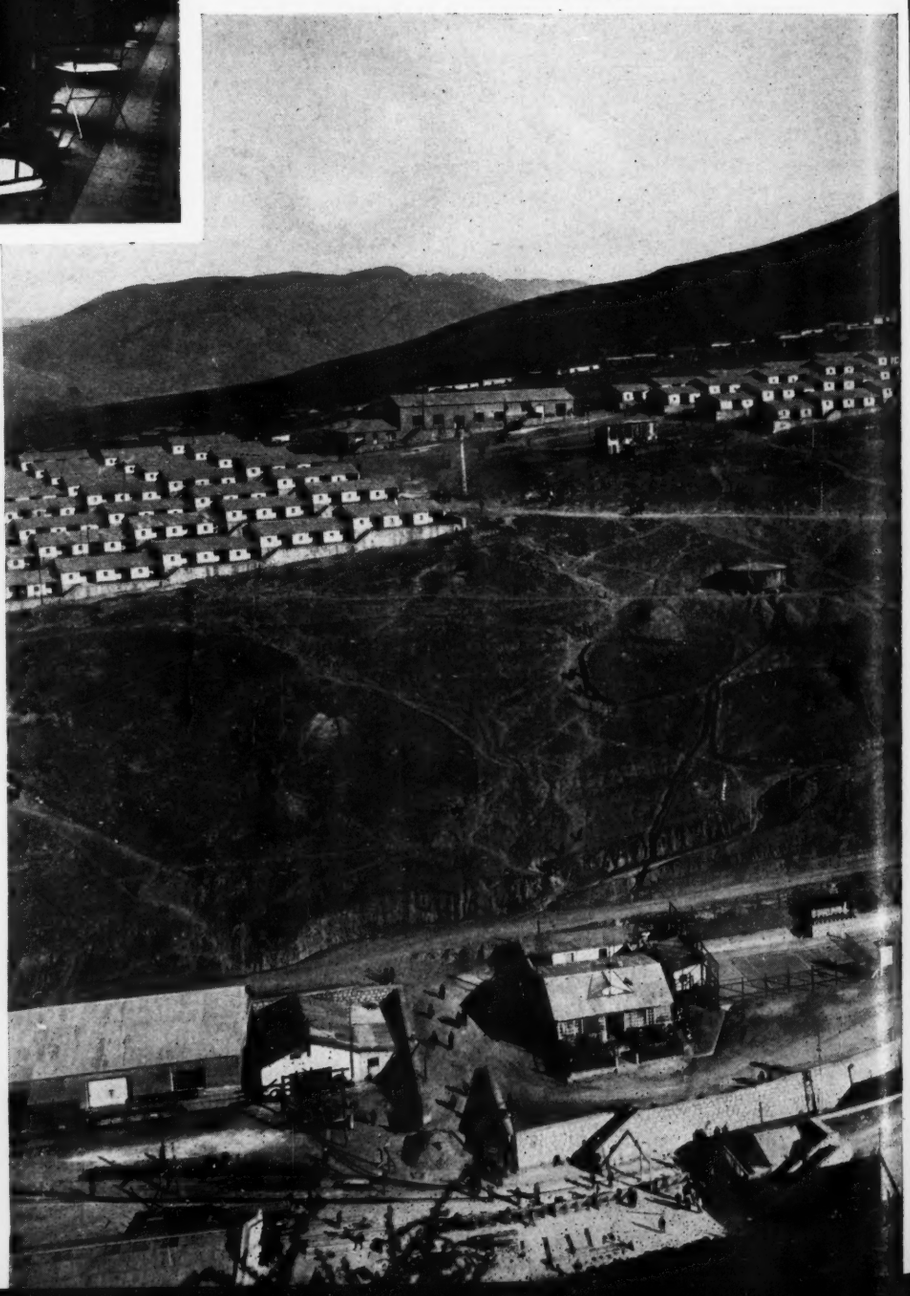
THE GENERAL HOSPITAL, at Catavi, the *patio* of which is seen here, is one of the finest in the mining industry in South America. On its staff are six doctors, seven nurses, and two pharmacists, as well as clerical and other employees

ON THE GOLF LINKS, a constant source of healthful entertainment. The local topography provides many natural hazards, to which others have been added

INDIAN LABORERS, in the Patiño company's employ. This group of fine-looking individuals has been posed

SIGLO XX CAMP

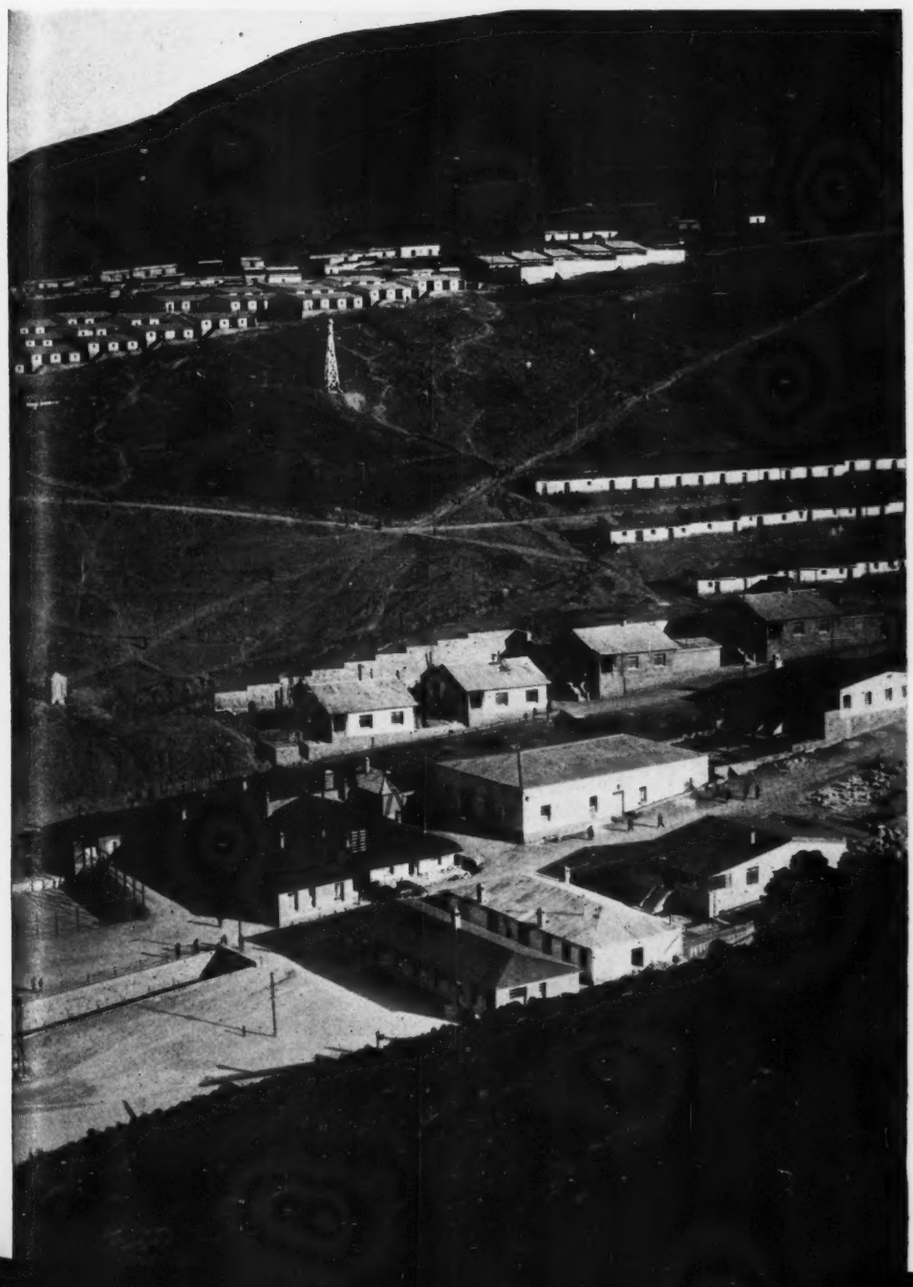
in partial view. The portal of Siglo XX tunnel is in the center foreground. Part of the workmen's camp is seen on the hillside above



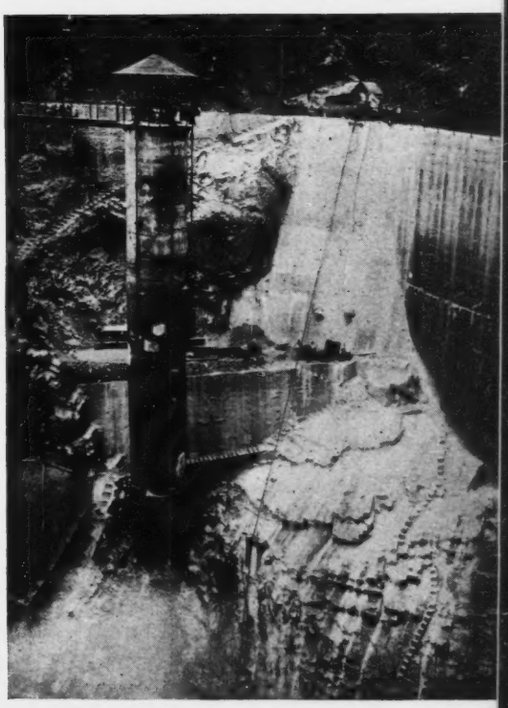
HAULING ORE on the company railroad from the Siglo XX sorting plant to the mill at Catavi. The cars are of 30 tons' capacity

MAIN STREET, Catavi. On the right can be seen the company store, school, theatre, and administration building. On the left is the carpenter shop

AT CATAVI, a street in the new colony. At 500 mete from the town, natural hot springs occur, from whi water having certain healing qualities is piped two swimming pools for workmen and staff



EMPLOYEES' HOUSES at Siglo XX (upper picture). T company provides furnished dwellings for all marri men and staff houses for single members



THE POWER DAM, 76 meters high, at Lupi Lupi. half mile below is the 1,120-kw. hydro-electric pla Besides this there is another hydro-electric plant, well as two diesel plants, the total rating of four being 6,627 kw.

ing sudden release of pressure and a corresponding rapid fall in temperature must be kept in mind.

Mineralization was probably one continuous process with minor oscillations within the main period. These pulsations are recorded by banding, which is in some places noted in the vein structure. There was probably first a period of high-temperature deposition as the solutions advanced, climaxed by a sudden release of pressure and decrease in temperature, and finally a period of low-temperature deposition. This cycle is recorded by the early formation of tourmaline, cassiterite, and bismuthinite; and inasmuch as these minerals, which are usually considered of high-temperature association, were deposited under near surface conditions, they were probably formed in conjunction with the explosive action. The presence of low-temperature minerals such as marcasite, sphalerite, and pyrite, deposited after the early, high-temperature period, indicates that these minerals were formed after the explosive action and represent a later period of mineralization. As already noted, there were minor oscillations during the general cycle.

The temperature range was great, and the conditions of deposition were unusual, though not without parallel. The association of minerals is unique and could have been produced only under such a combination of unusual features. Abundant hypogene replacement of pyrrhotite by pyrite and marcasite is distinctive.

An accessory mineral which can be used as an indicator in vertical hypogene zoning appears to be lacking. Bismuthinite is found intimately associated with high-grade cassiterite, but there is no particular zone where it is especially abundant. Sphalerite is found in all parts of the mine and cannot be used as an indicator. Other accessory minerals are either so widely distributed that they are not significant in zoning or are found in such negligible quantities that they cannot be used.

Lateral zoning exists in the sense that as the porphyry-sedimentary contact is reached and the veins begin to decrease in value, an increase in pyrite and in silver values takes place. This increase in silver content is not sufficient to produce silver veins of economic value, but is significant as an indicator of a decreasing tin content.

The problem of "fringe" mineralization is being given consideration and is one of great importance, because if the origin of this type of mineralization, typified by veins which lie outside the present mine workings, can be determined, either the further exploration of these veins may be continued with definite hope that as the mineralization reaches depth, the silver content will decrease and tin be encountered, or this class of veins may be condemned as representing a mineralization entirely separate from the tin-producing veins, and therefore not likely to warrant further investigation. Several such veins are found which are not connected to the known valuable deposits. They do not show consistent values on the surface and some have been prospected to a depth of 150 meters with no change in the character of mineralization or in the tin content.

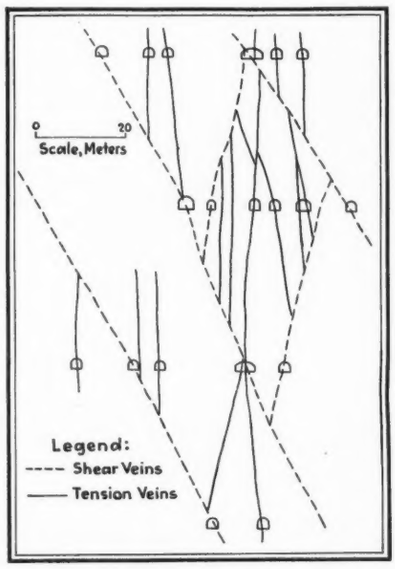


Fig. 4 . . . THE RELATION of the tension veins to the shear veins, the two principal types at Llallagua, is indicated by this cross-section

The Utilization of Geology—From the foregoing discussion of the geologic setting of the deposit, the ore formation, and the vein structure, a conception of the geological problems at Llallagua may be gained.

In 1925 the mine was examined by the consulting firm of Yeatman & Berry, of New York. They prepared the first longitudinal sections, systematically sampled the mine and calculated the ore reserves, and established the fundamentals upon which the geological department was founded. The geological department, in its present aspect, was established in 1927. The task of underground mapping was begun and the office maps were prepared. During the early history of the department assistance was given to the operators only on important development projects and on fault recoveries. Later, as the practical value of the geological work was increasingly appreciated, additional duties were assumed and the work was enlarged until it has reached its present status.

All horizontal underground workings, these totaling over 100 miles, have been mapped on a scale of 1:500. Current development is mapped monthly or more frequently, as required. Where advance has not been surveyed with the transit, the geologist posts his notes on a Brunton survey, later posting the data on the permanent office records. This renders immediate geologic information available to the foreman for use in guiding the subsequent development work.

It is essential that the geologist recognize the relative structural importance of the exposures underground and that the mapping be done with engineering accuracy.

The 1:500 maps form the basis for most other geologic maps, but maps on a smaller scale are also required, so maps on a scale of 1:1,000 are prepared. For study of the more general features this scale has proved satisfactory. A generalized plan of the principal veins and faults on a typical mine level is illustrated in Fig. 5.

The areal geology of the region surrounding the intrusive has been mapped, Fig. 3. This map covers an area of 35 sq. km., lying chiefly along the major anticline intruded by the porphyry. It has proved valuable in studying the geology of the deposit and its relation to the surrounding sedimentary formations.

For special studies of certain localities other maps are made as needed. In areas of complex structure special cross-section maps are of great value. Longitudinal sections, on a scale of 1:500, are prepared for each vein and vein branch. Use of them aids foreman and geologist in directing stoping and other work.

Geological guidance is essential to development and mining of veins where the structure is complex and the ore widely and irregularly distributed. All development work is under the direction of the geological department, and assistance is given to the mining department in stoping operations and other phases of the work.

Hunting new ore is the geologist's prime work. The abundance of veins and the complexity of their structure require constant and careful observation and the ability to estimate geologic values and coordinate the geological work with practical mining problems.

The work of the geological department is essentially one of service. Close cooperation is maintained at all times with both the miners and the engineers.

At the same time the study of purely geological problems is in progress: to gain a broader knowledge of the general geology, to solve the fault problems, to interpret the mechanics of the vein structure, and to investigate such features as zoning and other aspects of ore formation and mineralogy.

Sampling—The direction of all sampling is under the geological department. The sampling department consists of a chief sampler, three calculators, about fifty mine samplers, and from five to ten men used for special work on the surface. An average of about 325 mine samples are taken daily.

Sampling of the veins at Llallagua offers many difficult and unique problems. The veins are very high in grade and most are narrow in width, and the wall rock is usually hard. A drift may follow one vein structure which is divided into several small veinlets with strips of waste between.

All development faces, both horizontal and vertical, are sampled at 2-meter intervals. Where the values appear to have changed, the foreman in charge often requests a special sample of the face, to ascertain if the broken muck should be treated as ore or waste. Crosscuts are sampled as requested by the geologist or foreman in charge of the work. Unless, from the appearance of the rock, the geologist is sure that there is no possibility of ore, crosscuts are sampled as a matter of precaution so that nothing of possible value will be overlooked.

The method of fractional sampling is used; that is, each sample cut is divided into portions or fractions, each portion representing a division of vein or waste and making a separate sample for assay. In drift sampling, one sample cut is made up of an average of about six individual samples. The assay results of the fractional samples are then combined, by use of the gravimetric method, to give the average grade for the full sample cut.

In sampling crosscuts, "band" samples are taken: the fractional method is applied, but a horizontal cut is taken along the wall of the crosscut. In sampling either backs or walls, no individual sample governs a width of more than 1 meter. Stopes are sampled monthly, and inasmuch as the average vertical advance in a stope is from 1.5 to 4.0 meters per month, this results in a sample for roughly every 2 meters of advance. This method of fractional sampling not only gives the average width and grade of the sample cut, but shows what part carries the values and is essential to selective mining operations.

Recently a method of recording stope samples has been inaugurated which is really a combined sample and geologic sketch for each stope. It includes a horizontal plan of the stope showing each sample cut, with the corresponding assay of each fractional part; also on this plan are plotted all veins and other structural data. A side column gives the width and assay of each cut and the average for the entire stope. This horizontal plan is accompanied by a longitudinal section of the stope on which the location of each sample is also shown.

Training of samplers is difficult. The class of labor available is of a low standard, and experience has shown that the most successful method is to reduce the entire procedure to a standard and to allow as few variations as possible. The extent of the mine workings presents a problem in sample location; and the accurate and detailed location of each sample cut is vital to avoid confusion in filing and checking the samples. Check sampling is also a most necessary part of the routine work.

Assay maps are kept up to date monthly. Each sample is plotted with its assay value and corrected width. The practical mining width is considered 1 meter, but drifts are driven 1.80 meters wide and the excess width is reduced when calculating the stoping grade of the sample cut. This reduced width is the "corrected" width and is used for the ore-reserve calculations and is shown on the assay maps.

Annual calculation of the ore reserves constitutes one of the most important divisions of the geological work. Each vein system is calculated separately, and corresponding maps are made of each vein and its branches, showing the location of all ore blocks, stopes, and other workings. To accompany these longitudinal sections are the correlation maps, which show the location of each vein and branch.

The following data, copied from the ore reserve calculation as of Dec. 31, 1935, may be of interest: Number of vein systems, 46; number of vein branches, 965; number of ore-reserve maps, 132; and number of ore-reserve blocks, 2133.

(*To be continued*)

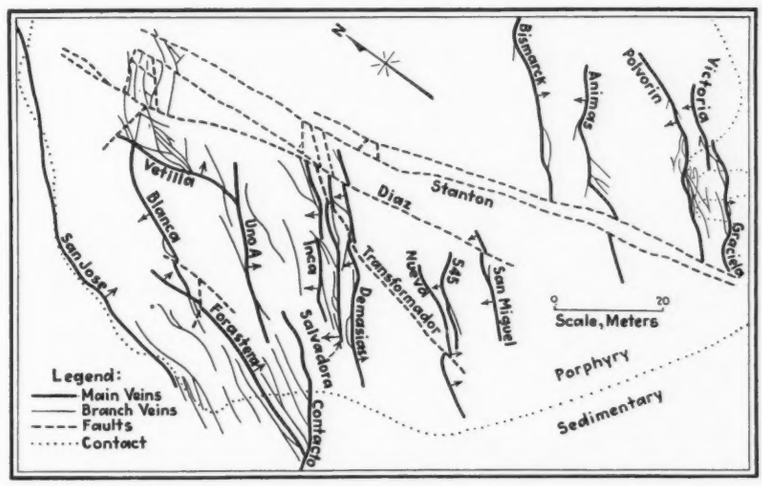


Fig. 5 . . . VEIN AND FAULT structure as developed on a typical mine level at Llallagua is illustrated in this generalized plan

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Setting Line Plugs Quickly

MINE CONTRACTORS always plan to save time in driving drift, tunnels, or crosscuts. Sometimes their routine is upset when forced to suspend work because the surveyor is checking up on the line and grade. The surveyor's work is sometimes tedious and done under difficult circumstances, and after he has set his head line plug he woefully finds the work must be repeated because the line hits outside of the plug. This situation usually loses time for the contractor, and sometimes he caustically expresses his opinion of mine surveyors and engineering schools in general. To expedite work of this nature in the least possible time, Fritz Turban, of Balderas-126 C, Mexico, D. F., uses the following method:

When a drift needs new lines, the helpers drill two holes for each plug required, 4 or 6 in. to the right and left of a marked center determined by hanging up the plumb bobs on the last two points and marking the center by sighting along these plumb lines. A stoping machine set up outside of the track, so as to maintain tramming, drills two short holes, into which two wooden plugs are securely driven. A board 10 or 14 in. long, 3 in. wide, and 1 in. thick is nailed to the inserted plugs with two 4-in. nails. The instrument is then set up, backsight taken, the angle turned, and the point marked for the spad on the board. About ten minutes' time is lost by the contractor. Grade plugs are set on the side of the drift in a similar manner.

An Eye to the Depreciation Reserve

Practice Followed Must Be Frequently Reviewed

MANY changing factors, the principal one of which is legislation, make it necessary to review the depreciation reserve policies of a corporation frequently. Laws enacted in 1936 have a far-reaching effect upon depreciation reserves, dividends, taxes, costing, and commodity pricing. As a contribution to the development of sound policies on reserves for depreciation, a committee of the Machinery and Allied Products Institute has published a report[1] on the subject. The following is an excerpt:

The principal new factor affecting a corporation's depreciation reserve policies and practices is the Revenue Act of 1936, which includes in addition to normal Federal corporation income tax an undistributed surplus tax ranging from 7 per cent to 27 per cent of the undistributed book income.

Formerly if a taxpayer failed to charge adequately for depreciation and obsolescence, his resulting maximum loss was the normal income tax on the amount by which such deduction for depreciation was inadequate. If all apparent income was then disbursed in dividends, capital impairment would have occurred, but corporations usually retained a considerable part of apparent income in surplus, and capital impairment was by this practice avoided.

Under the 1936 Revenue Act, circumstances are dangerously altered. Not only is there the loss of normal income tax upon the amount by which depreciation deduction was inadequate, but in addition a superimposed penalty —the corporation undistributed surplus tax of 7 to 27 per cent—upon such amount of apparent or book income. If excessive dividend disbursements are made to obtain a lower undistributed surplus tax rate, serious capital impairment occurs. In the event of subsequent disallowance of depreciation deductions, a further book profit results, and a dividend-paid credit cannot be retroactively applied against it.

Adequate ledgers and budgetary control of depreciation accounts are rare, and as a result of inability of the taxpayer to justify rates charged, numerous incidents of forced decrease in depreciation are reported. If facts were known and recorded there would be no justification or opportunity for arbitrary dictation of rates by government. Management is best informed on the value-in-use of its assets and is best fitted to establish required charges for depreciation reserves. Properly supported and recorded, the established charges become an element in determining costs, taxes, and value, fully acceptable to taxing bodies.

Policies

THE prime objective of the Committee in its study of practices and requirements has been to formulate depreciation reserve policies acceptable to management, finance, and legislative bodies, cutting through the complexities which have gradually developed since the enactment of the first corporate income tax law. Such policies, expressed in these three points, are recommended for adoption by industrial management to govern depreciation reserves.

1. *Purpose*—Since investment of capital in an asset is in reality prepaid depreciation expense, the principal purposes of establishing depreciation reserves through current charges to income are:

(a) To maintain capital investment intact.

(b) To recover the cost of the asset from the selling price of the product of the asset during the useful life of the asset.

2. *Method of Accumulation of Depreciation Reserves*—Nationally standard rates or methods are not practical. The prediction of the probable life and productiveness of an asset is essentially a management problem requiring, in each individual case:

FIRST, consideration at the time of acquisition of the asset of:

(a) Wear because of use.
(b) Obsolescence of asset.
(c) Obsolescence of product.
(d) The rate and method of recovery of the cost of the asset.

SECOND, redetermination of the useful economic life of the asset at periodic intervals to reconcile predicted life to actual life in practice.

3. *Use of Depreciation Reserve Funds*—Depreciation reserves accumulated from the selling price of a product of an asset should be subjected to the same budgetary control and accounting record as other elements of production cost.

Discussion of Recommended Policies

TO KEEP capital investment intact, it is desirable that the depreciation reserve funds be maintained in assets at the same rate at which depreciation actually occurs. In periods of zero production, or greatest loss, depreciation elements which continue regardless of the idleness of the asset are in fact losses of capital. Naturally it follows that in any period of losses, unrecovered depreciation reserves are losses of capital.

Depreciation is just as real a part of costs as the "cash" burden items of rent, power, taxes, labor and material, which are contracted, metered or assessed as the case may be, and which are currently paid for as used. Depreciation differs from "cash" burden items in that the elements of depreciation, wear, and obsolescence in many forms are not subject to the same accurate forecasts for short periods as are the other cost elements. Depreciation is the one element of cost paid *ahead* of use.

As an element of cost, provision for depreciation is subject to the same policy for both economic and tax considerations.

The policies proposed allow the latitude necessary for application to the diverse employment of capital assets. Although nationally standard rates or methods are not practical, it is probable that somewhat definite standards may be found common to competing industries. Differences must be recognized such as exist between depreciation in the mass-production and specialized-use industries with rapid obsolescence, and in the capital-goods

[1] "Depreciation Reserve Policies." Machinery and Allied Products Institute, 221 La Salle St., Chicago, Ill.

industries with more diversified use of assets. Individual plants present individual problems.

An asset as defined may be an individual capital unit, a group of pieces of equipment forming a unit, or even a whole plant.

The policies proposed do not prohibit the establishment of rates or methods of accumulation for recovery, but do require periodic review of the accuracy of any rates or methods used. Depreciation is not fixed but is as subject to change as any factor in any business. Technological progress is shortening the time that assets stay modern. Therefore, depreciation-reserve practice and policy requires periodic review, and rates applied do not merit the permanence that is frequently and incorrectly ascribed to them.

The recommended depreciation-reserve policy does not advocate higher or lower rates—rather it aims toward the establishment of factual rates supported by records.

The amount of depreciation charged to costs and recovered in sales prices should, in theory, be set aside in a separate cash account, or invested in liquid securities, to assure availability when required for replacement. The use of recovered depreciation reserve funds, however, is an individual management problem. Such funds should be budgeted, controlled, and accounted for as are other elements of production cost. The creation of separate reserve funds may be undesirable in many cases, due to the need of increased mechanization in order to lower production costs, and due to the greater earning power of the funds normally available to business use.

In practice depreciation funds can generally be employed to better advantage in the business itself, in repaying bank loans and increasing working capital. In such case, however, management must bear in mind that such funds have in effect been borrowed from capital for current purposes and either must be restored to capital when replacements are made or otherwise be available from another source.

Applying the Recommended Policies

EXECUTIVE OFFICERS responsible for financial policies of the company should authorize the installation of a "Plant Ledger," in which would be compiled the necessary data concerning each piece of fixed or major equipment, together with auxiliary equipment such as shafting, belts, pulleys, and other equipment, by group units, to show:

1. Description of unit.
2. Date installed.
3. Cost—
   (a) Of unit.
   (b) Of installation—estimated if necessary.
4. Plant location.
5. Type of work performed—
   (a) At present.
   (b) Any change-over from original purpose.
6. Report of superintendent or foreman of present use of unit and present condition.
7. Opinion of superintendent and foreman as to further useful life.
8. Other pertinent data which would fully inform management of the character of the equipment and the condition of that equipment from an operating standpoint with regard to product now produced.

There should be an assignment of values to these units of equipment which, in total, will agree with either the gross value less accumulated depreciation reserves as shown on the financial books, or the net value of the fixed assets carried on the financial books. It probably will be necessary in any case to apportion, somewhat arbitrarily, these dollar values.

The set-up of initial information for new equipment purchased should permit of historical data from which to determine in the future the condition and value in use of this equipment.

In most cases, depreciation deductions of the past, as accumulated in reserves, are probably not possible of identification in corresponding asset accounts or as capital losses. Replacement of equipment costing in excess of current provision for depreciation therefore will probably be necessary out of new capital funds, as the present tax laws which penalize undistributed earnings will impose possibly undue hardships on the retention of earnings in the business.

In the future the accounting records should be sufficient in scope to keep the executive informed as to whether the reserves for depreciation are (1) set aside in an investment fund of securities, (2) being used to acquire additional equipment, (3) borrowed for working capital to avoid bank loans, or (4) really eating up capital.

When it is necessary to convert equipment to meet changes in manufacturing procedure, complete records of this change-over should be reflected in the plant ledger.

If a revision of the value of the equipment for future use is necessary, the adjustment of loss, if any, should be made and proper adjustment also be provided with respect to depreciation allowances for the future.

The subject is by no means a simple one and the procedure to be adopted to obtain the information will, of necessity, be different in one plant from another.

Losses From Unsound Policies

UNSOUND depreciation reserve policies resulting from lack of knowledge of true costs are reflected in—

1. Reduction of ability to modernize.
2. Depletion of capital.
3. Sales below cost.
4. Financial statements reflecting unsound values.
5. Doubtful statistical and cost data.
6. Inaccurate guidance for financial, managerial, legislative, and taxing bodies.

The practice of regular replacement of equipment is a desirable one. Advantage is enjoyed of using up-to-date equipment, with costs at minimum, and necessity is avoided for large special appropriations for replacements, often difficult to finance.

Three Common Errors

COMMON ERRORS found in the computation and utilization of depreciation reserves warrant especial mention:

FIRST, the most serious error—the arbitrary setting of annual depreciation charges to effect more favorable balance sheets.

SECOND, the most prevalent error—the adherence to book values regardless of economic values. Book value of an asset is by no means necessarily the real value. Replacement studies must not be influenced by book values.

THIRD, failure to direct recovered depreciation reserves into rehabilitation channels. To use depreciation recoveries for other purposes is like an individual borrowing on a life insurance policy to pay current living expenses.

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Removing Pipe Plugs

When the practice is followed of keeping a loose pipe plug on a tank or at the end of a fuel or water pipe to close it against rain or dust, it usually happens, should one want to unscrew it, that a special trip has to be made for a wrench. To save that extra trip, Charles Labbe, Goldfield, Nev., suggests drilling a hole through the square part of the plug and inserting a long bolt, with a nut on the end, to serve as a handle.

Are You Going to the Tropics?

HAULING a loaded dug-out up the rapids

These Suggestions Will Be Helpful

Lucien Eaton

Consulting Mining Engineer
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THOUGH the seasonal variations in temperature in the tropics are not as wide as those in the temperate zone, the differences in comfort due to the wet and dry seasons may be almost as great. The time of year at which the wet season is to be expected and its duration vary widely even on the same continent. Usually there is only one wet season, but in a few places, such as the headwaters of the Nile, there are two such periods, and on the west coast of Peru there is none. In Colombia and Panama the dry season is from December to April, but in eastern Peru and Bolivia this is the wet season. General information in regard to seasons, rainfall, and temperature can usually be found in the encyclopedia, but more specific data should be obtained from a consul of the country to be visited.

If the journey is to be made into high mountains, the climate is likely to be that of the temperate zone, and clothing and equipment for a tropical climate may be needed for only that part of the journey that is at a low elevation, and, if this is on the regular routes of travel, the selection of clothing and equipage is a simple matter. One must also take into consideration the time of year of one's departure and return, and be provided with suitable clothing accordingly. It may be convenient to leave clothing at the port of entry and pick it up on the return journey.

A passport is, of course, required, and visas for the countries to be visited must be obtained from their respective consuls. Information should be obtained in regard to duties and customs regulations, landing permits, and so on. Nearly all tropical countries require a vaccination certificate of less than three years' standing and a certificate of general good health. Some countries require, in addition, a certificate from a judge that the traveler has not been convicted of crime in the past five years. These certificates should be pasted in the back of the passport. Extra passport photographs should be carried also, because they may be needed for various local permits, such as for receipt of mail, telegrams, and so forth. Moreover, in some countries a deposit of $100, or some such amount, must be made with the customs on landing as a guaranty of return passage to the United States. A permit may be required before this deposit can be reclaimed. There may be a landing tax and even an embarkation tax. Sometimes it is as difficult and expensive to get out of a country as it is to get in.

When being vaccinated, one should also be inoculated against typhoid and paratyphoid. This requires two weeks and may cause some inconvenience, but is effective for two to three years. There are other inoculations against specific diseases that may be taken, but unfortunately there is no inoculation against malaria or amoebic dysentery.

In many tropical countries a letter of credit is not as convenient a way of carrying funds as American Express checks, which are in great demand in countries where there is governmental control over foreign exchange. A good many checks of small denominations, $10 and $20, should be included. In the Western Hemisphere they should be in United States dollars and in the Eastern Hemisphere in British pounds. Funds should be divided and not carried in one lump. A substantial amount should be carried in a pouch or belt under the clothing. A woman's money pouch, which hangs from a tape belt, is much more comfortable to wear in hot weather than a money belt. If there is serious danger of pocket-picking, an envelope attached to the skin on one side of the chest by strips of 1-in. adhesive tape is convenient and safe. It cannot be

removed from a sleeping person without waking him, and is not uncomfortable; but in a hot, humid climate it is not always easy to make the plaster stick to the skin.

Before going into the back country away from towns where there are banks, a goodly supply of small change, mostly silver, should be obtained, because it is usually impossible to get large bills changed. For instance, in the intendencia of the Chocó, in Colombia, all purchases made outside of the larger towns must be paid for in "plata vieja," old silver, consisting of the silver coins of all Central and South American countries and Mexico and even of some European countries, although the legal money is gold or gold certificates.

That adequate information is so scant in regard to clothing and equipment needed for travel in the tropics, especially for a journey far from the centers of population, is surprising. When planning for such a journey, one should, if possible, consult someone who has made the same journey or a similar one, but in so doing allowance must be made for personal habits and tastes. An endeavor should be made to "travel light," and unnecessary articles should be omitted, but at the same time care should be exercised that articles which are really needed are not left behind. To "rough it" unnecessarily is a mistake, and a balance must be struck between the amount of trouble caused by carrying a piece of equipment and the benefits or comforts that its possession will give.

Standardization of containers is a great help in both packing and unpacking. If the containers are numbered and a record is kept of the contents of each one, checking up in transit will be facilitated, losses will be easy to detect and prevent, and much unnecessary packing and unpacking will be avoided.

Baggage—If baggage has to be carried by mules or men, or in canoes or automobiles, the units should not weigh more than 100 lb. each. The ordinary steamer trunk should not be used if travel away from steamer and railroad is contemplated. Instead, two smaller trunks or bags should be carried, which should preferably be similar so that they will balance well on mule-back. For this service the United States Army locker trunk is quite suitable. It measures 31 in. by 17 in. by 13½ in. outside, is reasonably resistant to rain, and has a substantial snap lock. In damp countries and in those infested with ants and termites sheet-iron trunks are most satisfactory. They come in various sizes, two convenient sizes being 29 in. long by 16 in. wide and 11 in. deep and 26 in. by 14 in. by 10 in. The less expensive types have two padlocks. They are very useful for storing and transporting samples and specimens as well as clothing and miscellaneous equipment. Larger sizes can be obtained. Another convenient kind of luggage is the so-called "Pullman trunk." It is a fiber suitcase, 30 in. by 17 in. by 9 in., and is really a hand bag, but makes an excellent small trunk if handles are put on the ends. A large amount of clothing can be packed in two or three of these bags. Fiber trunks or bags should not be left on damp ground, and should have canvas covers for mule-back transportation.

For going into the "bush" a sheet-iron trunk or two and a duffle bag make a good combination. Waterproof duffle bags approximately 34 in. long and 10 in. in diameter, closed at the side with Talon fasteners and provided with locks, can be bought, and are more convenient than those that open only at the end. A medium-sized packsack, such as is used in the northern "bush" of North America, is a convenient thing to have along. In wet countries like Colombia, Panama, and eastern Peru sacks covered with raw rubber are used for carrying clothing. Such a sack is approximately 36 in. long by 22 in. wide, and is really waterproof, but it must be covered with another sack to protect the rubber coating from abrasion. These sacks can be purchased only locally.

All baggage should be plainly marked with the owner's name and should have a distinctive mark or stripe in some bright-colored enamel on the faces most likely to be seen when the baggage is piled. In some countries in South America it is customary to sew up in burlap all baggage that is checked in the baggage car or is transported not in the owner's care. This is also good practice for the mule trail in wet weather, each package being wrapped in waterproof paper under the burlap.

Clothing—For the voyage and for the railway journey to the point of departure for the interior the same sort of clothing as would be worn on a summer cruise in more northern latitudes should be taken, but the wardrobe should contain a larger number of washable cotton suits. Items for consideration are given in Table I.

Evening dress is almost obligatory on British ships and in the colonies, but on American ships sailing to South American ports it is not needed. It is always best, however, to take dress clothes along, for one never knows when they may be needed ashore. The compliment implied by wearing evening dress is highly appreciated by our Latin American friends. For evening dress three or four dress shirts, six dress collars, and two black ties are usually enough for the voyage, and on long voyages of two weeks or more, such as from Southampton to Capetown, soft white shirts can be worn as dress shirts part of the time. It is seldom that any starched laundry can be done on board.

A TYPICAL CAMP for two white men. It is without sides or floor, sticks being laid on the ground to stand on. The cheesecloth mosquito bar for the cot at the left has been put away for the day. The table is set and the washing is hung up to dry

Mosquito boots, soft leather boots that tie just below the knee, are very comfortable and are a great protection in the evening in malarial countries, where, as in Rhodesia, the ground is likely to be dry underfoot.

For the "bush" of Northern Rhodesia and neighboring countries the army breeches, khaki jacket, rubber shoes, and slicker should be

Table I—Clothing

1 raincoat
1 light overcoat
1 felt hat, cap, or beret
1 sweater
1 dark suit or brown tweeds
1 pair light gray or white flannel trousers
white shorts and sport shirts
2 or more white duck or drill suits
1 tropical suit unbleached linen
2 mess jackets or white Tuxedo (optional)
1 bathing suit
6 shirts, collars unattached
3 shirts, collars attached
12 soft collars
3 neckties
1 belt
4 or 6 suits underwear
2 or 3 suits pajamas
12 handkerchiefs
8 pairs socks
1 pair garters
1 light, washable bathrobe
1 pair each street shoes, rubber soled shoes, dress shoes and sneakers.

Working Clothes

2 olive drab wool or cotton shirts
2 pair khaki army breeches
1 pair long khaki trousers
1 pair 16-in. leather boots, hobnailed soles
1 pair 16-in. laced rubber shoes with cleats
1 pair mosquito boots
6 pairs light wool socks
4 pairs short heavy wool socks
1 Stetson felt hat
1 khaki jacket or "lumber jacket"
1 slicker or poncho

omitted. In their place should be substituted two pairs of khaki shorts and two Rhodesian bush shirts, made of red-lined cloth, which can be purchased in Buluwayo on the way in. One should also have three pairs of golf stockings, one pair of golf garters, a pair of high tan shoes, United States Army last, a large red or brown silk handkerchief to protect the neck from the sun, a white tennis hat, and a dust coat. In Africa it is advisable to wear a sun helmet, although many Rhodesians and South Africans prefer a double felt hat, but in South and Central America helmets are not needed. A good felt hat for the rainy season and a panama or native straw hat for the dry season are all that are required. Sunstroke is almost unknown.

Accessories—In the selection of clothing for travel, as listed, there is less likelihood of error or omission than in the choice of accessories. These are included in Table II. Equipment and instruments for the examination or other work is left to the engineer's judgment. If fresh supplies cannot with certainty be obtained at the destination, extra soap, shaving cream, razor blades, tooth paste and an extra tooth brush should be taken along. Toilet paper and paper toilet-seat covers, the latter of which are now on the market, should not be forgotten.

A medicine kit is essential also. It should be packed in a box of the same size as that used for toilet articles, and as far as possible the contents should be in bottles or tin boxes rather than in flexible tubes. A good assortment of medical supplies is found in Table III. The 100 5-grain tablets of quinine hydrochlor should not be omitted. These tablets are apparently not manufactured in the United States, although the capsules can be obtained, and it is possible to get the bromide. These are much more expensive than the hydrochlor, however. Importing duggists usually carry Howard's or Burroughs and Wellcome's quinine hydrochlor, and these brands are recommended. Quinine sulphate is not recommended, because, if taken regularly and in quantity, it upsets the digestion.

A snake-bite kit, consisting of a metal tube containing a small knife point in one end and crystals of potassium permanganate in the other, should be included, and, if the country visited is infested with snakes, a hypodermic syringe, a sterilizer, two extra needles, and a bottle of material to be used for inoculation against snake bites are an extra precaution.

Table II—Accessories

2 hand towels
2 bath towels
2 washcloths or a sponge
1 washcloth bag
1 laundry bag
1 kit toilet articles packed in leather or tin box 10 in. by 6 in. by 2½ in. containing hair brushes, traveling cup, tooth brush, tooth paste, razor, shaving brush, shaving cream, dental floss, mouth wash, shaving mirror, soap dish and soap, jar of vaseline or cold cream
1 clothes brush
1 nail brush
1 shoe brush, shoe paste, and boot grease

Table III—Medical Supplies

100 5-grain aspirin
100 5-grain soda bicarbonate or milk of magnesia
100 ¼-grain calomel
100 5-grain Chlorazene
1 oz. tincture iodine
1 oz. tincture merthiolate, strength 1 to 1,000 or 1 oz 3—B solution
1 oz. S. T. 37 hexylresorcinol solution
1 oz. 10 per cent bone acid solution
¼ lb. Squibbs Epsom salt
½ oz. Unguentine
1 tube Baume Bengué
100 5-grain quinine hydrochlor
10 yd. ½-in. surgeon plaster
5 yd. 1-in. surgeon plaster
2 rolls 1-in. bandage
3 gauze packs
1 package Bandaid
1 package cotton swabs
1 camel's-hair brush
1 medicine dropper
1 clinical thermometer
1 pair scissors
1 hot-water bottle

In addition to miscellaneous items in Table IV, a spool or two of strong silk often comes in handy. The sewing kit can be packed in one compartment of a box of the same size as that used for the toilet articles, the other compartment being used for other small articles, or it can be packed in a cloth bag.

Two full sets of studs and cuff buttons should be carried, and it is well to take along an extra watch, and, if eyeglasses are worn, extra eyeglasses and a copy of the prescription for the lenses.

Films should be bought at home, and for the tropics special tropical films, sealed in lead cylinders, should be used. The films should be developed soon after they have been exposed, but, if this is impracticable, they can be kept in good condition for some time by putting the finished roll back in the lead case and sealing it with surgeon plaster. Deterioration on the return voyage can be retarded by having the exposed films stored in the ice-box on the ship. Four or five dozen exposures are usually enough for a three months' trip. Other accessories that are very useful when traveling off the beaten path are found in Table IV.

In traveling through the jungle one should carry a machete. The blade should be fairly straight and should be not less than 16 in. nor more than 29 in. long. The longer machetes are unwieldy in inexperienced hands, and those with curved blades are inferior as weapons of defense. Since most countries do not permit one to carry a pistol, or, at best, a permit to carry one must be bought in every intendencia, and since it is unwise to travel the back trails weaponless, the machete has in many places become an accepted article of apparel. It is of course essential in clearing paths through the jungle and in building shelters, and is useful in many other ways. It takes the place of the small axe usually carried in the northern woods. The No. 23 Collins machete, made by Collins & Company of Hartford, Conn., enjoys a good reputation in the tropics, and is much superior to most of those of foreign make. The machete should be carried in a leather sheath, attached to the belt on the left side.

If part of the journey is to be made on mule back, a whip or quirt and spurs should be purchased; and, if the journey is a long one, saddlebags should be bought also. They are convenient also as packs when traveling

Table IV—Sundries

1 sewing kit containing 1 package assorted needles, numbers 1 to 5, darning needles, 1 large spool each black, brown, and white thread; 1 spool each No. 30 cotton thread, black, brown, and white; assorted darning wool and cotton; assortment of buttons; lump of beeswax; 12 safety pins, card of pins; an emery ball, a thimble, tape measure, and scissors
extra shoestrings
1 small emery stone
1 small can 3-in-1 oil
1 pocket tool kit
1 pocket book
1 note book
1 diary
1 fountain pen; rubber ink bottle
1 Autopoint pencil
1 Scout model pocket knife
1 Marble match safe
1 Marble hunting compass
1 small aneroid barometer, and a thermometer
1 small alarm clock
1 keyholder
1 Boy Scout model 2-cell battery flashlight, 2 extra sets batteries, and bulbs
2 hard candles
1 camera in leather or rubber case and films in lead cylinders.
1 can insect powder (Keatings's or Flit) a fly swatter, and spray gun for Flit.
1 12-in. rubber or canvas basin
1 rubber tumbler
1 folding canvas bucket
1 needle and string for sewing burlap

afoot. They are best purchased locally. For riding in the rain a pommel-slicker is superior to a poncho or ordinary slicker, but it is too long for comfort in walking.

What About Bedding?—Unless one is going to be only in the larger cities, a full outfit of sleeping equipment should be carried. This will consist of a folding canvas cot, 28 in. wide by 6 ft. 4 in. long, folding to 38 in. by 7 in. by 7 in.; a kapok or cotton mattress; a white cotton mattress cover, three sheets, three pillow slips, a pillow, a single woolen blanket, and a cotton blanket. If the elevation is to be over 2,000 ft., a steamer rug, which will be useful on the voyage, or another woolen blanket should be added. The bedding should be carried in a waterproof canvas bedding roll, which should have two straps and a handle, and should be equipped with a chain and lock. It will be about 32 in. long and 18 in. in diameter when packed. The cot should be carried in a water-proof canvas bag, made especially for it.

The United States Army bedding roll is fairly satisfactory, but is rather bulky. To eliminate the bad points of the army type, the bed roll shown in Fig. 2 was designed. It is made of 8-oz. waterproof duck, and when not in use is rolled up and slipped into a bag or pack sack. It can be unrolled on top of the cot, with the pockets hanging down at the sides, or it can be made into a hammock or a cot. There are tubes for cross-poles at head and foot and for longitudinal poles at the sides. If the latter rest in crotched sticks driven into the ground, the bed-roll becomes a cot. If $\frac{3}{8}$-in. ropes are threaded through the side tubes and through the ends of the cross-pieces, it can be hung up as a hammock. In the jungle in Central America it is customary to camp under a roof thatched with palm fronds, no side walls or floor being provided, unless the stay is to be a long one, and beds are narrow platforms resting on crotched sticks. A bed roll such as that described can be set up almost as quickly as a cot, and is much lighter to carry. A light, folding canvas chair is a great convenience, and is worth carrying if the stay is to be a long one.

A good mosquito bar should be included always, when visiting malarial countries. Major Cuthbert Christy, in his "Notes on the Prevention of Malaria," which may be obtained from the Ross Institute and Hospital for Tropical Diseases, Putney Heath, London, S.W. 15, describes a proper mosquito bar (See Fig. 1) as follows:

"The smallest and lightest mosquito net, which can be made serviceable under all circumstances, . . . is one with calico top 5 ft. 6 in. long by 2 ft. broad, and sides 3 ft. 6 in. deep (2 ft. of netting and 1½ ft. of calico or jaconet valance for tucking in, and as some protection for knees, feet, and

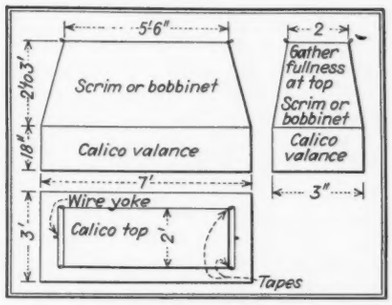

Fig. 1 . . . A MOSQUITO BAR that is cheap and serviceable. It also can be rolled and packed

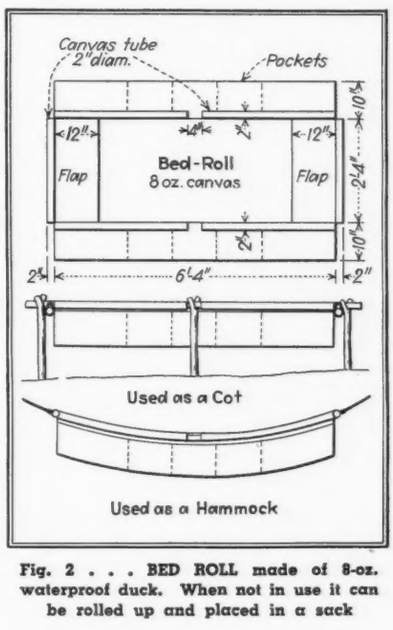

Fig. 2 . . . BED ROLL made of 8-oz. waterproof duck. When not in use it can be rolled up and placed in a sack

elbows). The netting should be cut so as to allow the net to be very much fuller at the bottom than at the top, to enable the occupant to get in and out conveniently. A mosquito net should always be entered back first, and not head first. At each of the four corners of the net there must be double tapes 8 in. long, for fixing it to its supports. To be efficient it must be suspended by these corner tapes inside the supporting rods; otherwise it cannot be tucked in effectively. On no account should it be placed over supports, or allowed to hang to the floor. . . . The strongest and most useful netting is what is known as unbleached. . . . The mesh should not be too large."

A mosquito bar of the type described, using cambric for top and valance, and "scrim," such as is used for curtains, for the sides, is superior to any on the market, and costs about $5. The mosquito bar should be high enough to permit a man to sit up in bed under it without touching the top with his head. The bar is supported by four strings attached to loops of tape at the upper corners, or by two strings, each of which is attached to a wire yoke that is hooked into the tape loops at each end. These yokes can be made from wire coat-hangers. In Rhodesia the favorite design is shaped like a high truncated cone, the top being spread by a circular wire ring about 30 in. in diameter. It is supported by a single string attached to the center of the top. When camping in the dry season, no other overhead protection is needed, and the mosquito bar is merely suspended from a limb of a tree. When traveling, the bar should be rolled up and be kept with the bedding in the bed roll. When not needed, it should be packed in its own cloth bag to keep it from being torn.

Mosquito bars can be obtained at most Boy Scout shops, but are likely to have too coarse mesh. They are supported at the ends by wire yokes. Many of the other accessories mentioned can also be obtained at these shops, one of which is Modell's Sporting Goods Company, 200 Broadway, New York.

When it is impossible to set up a mosquito bar at night, mosquitos can be kept off reasonably well for four to six hours by rubbing the exposed parts with a good "fly dope." Most of these preparations are disagreeable to use. Under most conditions 3-in-1 oil works well, but by far the best in my experience is "Bamber oil," a mixture of the following ingredients: Citronella oil, 1½ parts; kerosene, 1 part; cocoanut oil, 2 parts. To which is added carbolic acid 1 per cent.

"Bamber oil" is clean and pleasant to use, and the carbolic acts as a disinfectant for insect bites. Nine ounces will last a man about three months. In places that are infested with biting insects, it will, if applied freely on exposed parts both by day and night, add materially to one's comfort. It is recommended by the Ross Institute of Tropical Diseases.

In the battle against malarial infection a good mosquito bar properly used is the most effective protection. Mosquito boots and "Bamber oil," used after sunset in the evening, are also aids. Quinine is the only specific for the disease, and is also helpful in preventing infection. If taken regularly, it provides some degree of immunity from light attacks and makes heavier infections less severe. Since the malarial Anopheles mosquito does not come out until sundown and is most active for two or three hours thereafter, it is best to take a 5-grain tablet of quinine *with* the evening meal, not before it or after it. Whiskey is not beneficial, although in many parts of the world it is customary to have a "sundowner" every evening, and in Rhodesia it is the rule to keep the quinine next to the whiskey bottle, so that you won't forget it (the quinine).

Not all tropical countries are malarial, but where malaria does occur it is a scourge. Sometimes other fevers are

mistaken for malaria, and, as they do not respond to the same treatment as malaria, the consequences may be serious. This is true in Colombia, where in altitudes as high as 5,000 ft. and even higher relapsing fever is prevalent. This fever is carried by ticks or chinch bugs ("chinchas") just as the mosquito carries malaria. Its symptoms are so much like those of malaria that the two are often confused. Quinine has no beneficial effect on it, but it can be completely cured by an intravenous injection of salvarsan at the height of an attack. If not given at the height of an attack, two injections a week apart may be necessary. Although the idea is not accepted by some doctors, it seems reasonable to suppose that such an injection before exposure will furnish immunity for some weeks.

Be Careful What You Eat—In the tropics a man's health depends on what he eats and drinks even more than in the temperate zones. Except in the mountains it is seldom safe to drink any water that has not been boiled. If bottled water can be taken along, it will help amazingly. I have kept well on half a pint of bottled water a day, clear tea being my only other drink. I even used tea for cleaning my teeth. On the trail, water or tea should be carried in an aluminum canteen, and in dry climates it should be kept in camp in a canvas water bag, the evaporation from which will keep it cool. The bag should be sterilized frequently.

Because of the limitations imposed on the diet by general unsanitary conditions and by the rapidity with which fresh food spoils in the tropics, maintenance of a proper supply of vitamins is difficult, but this deficiency can to some extent be made up with concentrated extracts, such as Squibb's Adex tablets. Fresh vegetables and fresh fruit the skin of which is put into the mouth must never be eaten raw, but bananas and oranges and other fruit with strong protective skins are permissible.

If practicable, food native to the country should be eaten to a large extent. For example, in the tropics potatoes are scarce and poor in quality, and rice, yucca, and plátanos should be eaten in their stead. Corn meal takes the place of wheat flour to a large extent in many places. Canned baked beans are unsuitable food in hot weather, and should be avoided; but native red beans thoroughly boiled and served with red pepper sauce are readily digested. Meat should be eaten sparingly, and is best boiled and eaten in stew. Fish and game are scarce in the rainy season in most places, but, when obtainable, are a great help.

Too much reliance should not be placed on canned food, and it is a mistake to feed native workmen on it. They are not used to it, and it is expensive. In nearly every country there is a standard ration for workmen, and it should be provided; but in most places it is a mistake for the white man to try to live on the same diet as the native. Wherever there are people, eggs can usually be obtained, but milk and butter are generally out of the question. However, canned butter (Danish is usually best) is good and keeps well, and dried milk powder (KLIM) makes good milk.

If one is going into the wilds, personal attention should be paid to the quantity and quality of the food and the manner in which it is packed. In wet countries, if it is humanly possible, food should be packed in sealed tins. Flour, sugar, beans, rice, corn meal, and dried fruit should be packed in 50-lb. tins. If they can be obtained 5-gal. kerosene cans will serve. Tea, coffee, and salt should be in smaller tins. Coffee should be in whole beans, and should be roasted and ground a little at a time. If tins cannot be obtained, double waterproofed canvas bags will serve fairly well. The latex-covered bags that are made in Central and South America serve well, but are usually too large, and must be put inside other sacks for protection against abrasion. Beans, lentil, rice, and coffee can be carried on boat trips in carboys covered with woven rattan or *bejuco,* but it is not safe to carry sugar or flour in this way, because the mouth of the bottle is too small. Each package should be sealed and plainly marked with a number or with the name of its contents, or both.

If supplies are properly packed, enough food for the whole journey can often be taken along, caches being left at convenient points for use on the return trip, and the trouble and expense of maintaining a line of communication can be avoided.

A supply of kerosene is almost a necessity for starting fires in the rainy season, and two or three lanterns will be needed for light. The kerosene cans, when empty, can be used as pails or ovens. In some places canned goods are valued more for the container than for the contents. In order that empty cans may be made into cups and pots, the can opener should be of the type that leaves the edge of the can smooth and rounded.

Dishes, cups, and most cooking utensils should be of enameled ware, and a complete and separate set should be provided for the white men. Dishes should be washed with hot water and strong soap after every meal, so that dysentery may be avoided. A plentiful supply of soap for washing dishes and clothes should be carried, and it should be in relatively small cakes. Cooking equipment should be packed in covered boxes with locks.

If proper care and forethought are exercised, one may keep well and fit when traveling in the tropics, and what might otherwise be hardship and even danger may become a pleasant and enjoyable experience.

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Plow Marks Placer Ground

AN INNOVATION at the placer operation of Ferries & Marchbank near John Day, Ore., is the method of marking ground ahead of the large diesel-electric dragline to insure proper advance and simplify calculation of yardage to be dug.

Special plow for marking placer ground ahead of dragline at the Ferries & Marchbank operation near John Day, Ore. Mr. Creeden, the inventor, is holding the plow

Usually, the operator of the digging unit is guided by wooden stakes driven at intervals determined by the superintendent or dredge master. However, experience has shown that deviations from the marked course occur frequently because of the difficulty of seeing the stakes at night, and the fact that they are accidentally removed or destroyed at times by the tractors moving in supplies and other field equipment employed in an operation of this kind.

C. C. Creeden, superintendent, overcame this difficulty by constructing the plow shown in the accompanying halftone. It consists of a rectangular cutting element with a curved tail to facilitate discharge of the plowed-up overburden; a sturdy square frame made from strap iron; two guide shoes; a saddle piece forged from an old section of steel rail; and a steel lever and tail extension to guide and weight the plow. The cutting depth can be changed at will by simply lowering or raising the two guide shoes bolted to the sides of the plow frame. A small tractor is used for towing the plow.

Splitting Small Samples Accurately

With the Microsplitter

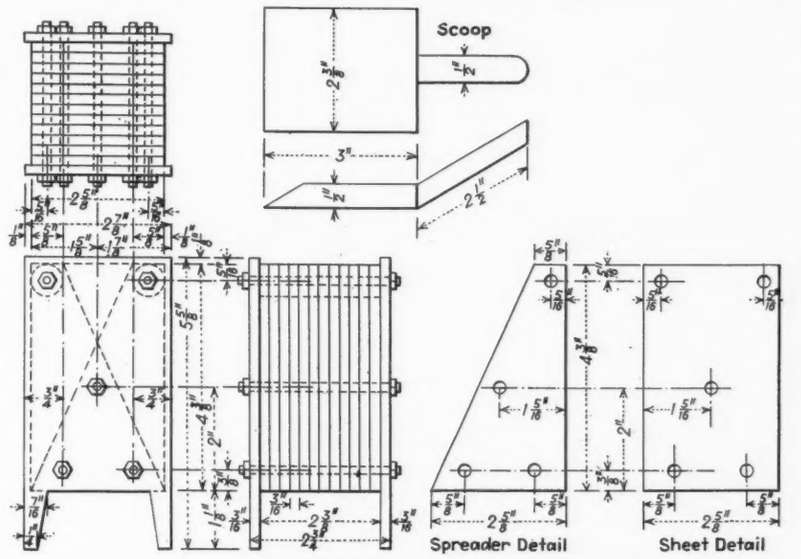


Fig. 1 . . . A MICROSPLITTER of suitable dimensions for cutting down samples for assaying and chemical analysis

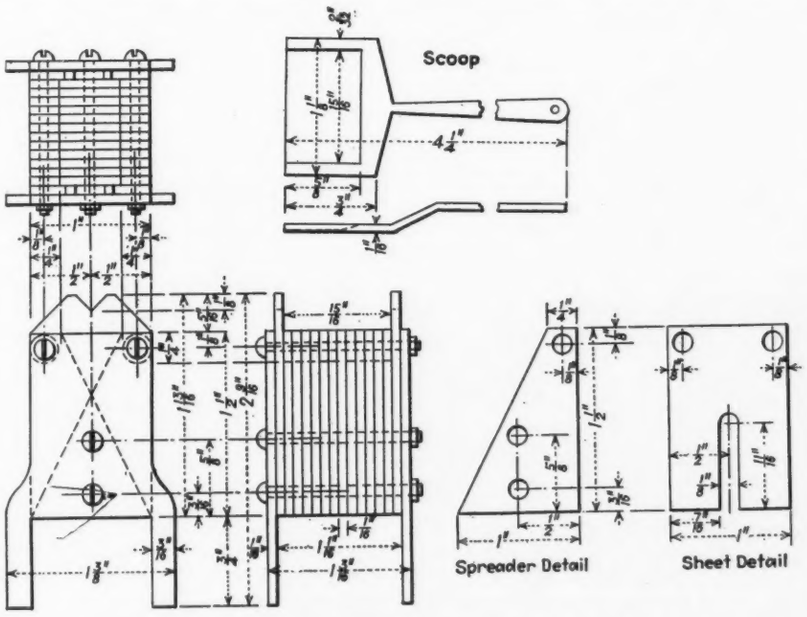


Fig. 2 . . . THIS MICROSPLITTER, of smaller size than that in Fig. 1, was designed for quantitative microscopic work

A MAXIM which is probably universally realized, but unfortunately not always practiced, is that no analysis can be more dependable than the method by which the sample is prepared. Although the analyst may take great care in preparing his samples, errors of considerable magnitude may occur unknown to him.

The ordinary steps preceding an analysis are roughly as follows: First, every precaution is usually taken that the original sample may be truly representative of the material to be analyzed. This original sample, if large, is carefully coned and quartered until small enough to handle with a Jones riffle. It is then cut with the riffle to several pounds, and next it is thoroughly rolled on a rolling cloth and coned and quartered until a sample weighing a pound or so results. Between various steps, of course, the sample is crushed finer. The final sample may be rolled on a cloth as many as fifty times to mix it thoroughly before it is placed in a sack as the prepared sample. From this sack portions are withdrawn from time to time by means of a spatula, to be weighed and analyzed.

Until the time the sample has been placed in the sack, everything may have been done as correctly as possible, and the sample may be truly representative of the original material. Thereafter, however, a number of sources of error may enter. In crushing the sample, certain minerals will have been ground finer than others. Each time the sack is handled a classifying action tends to take place; the heavier minerals, as well as the finer particles, tend to work their way toward the bottom; micaceous minerals tend to stratify, and so on. Moreover, whenever a portion is withdrawn with a spatula, other harmful effects may occur. The portion withdrawn is likely to contain relatively more of the finer minerals. If too much is withdrawn the excess is tapped off the spatula, which may result in an excess of the lighter and the larger minerals being returned to the sack. Thus the sample weighed out may be quite different from the sample as originally prepared, and the last sample weighed out may differ very appreciably from the first.

About ten years ago the need for a device with which small amounts of

The microsplitter is discussed briefly in U. S. Bureau of Mines R. I. 3290, "Statistical Microscopic Study of Ores and Mill Products From the Anyox Plant of the Granby Consolidated Mining, Smelting & Power Company, Ltd., Anyox, B. C.," by Head, Crawford, Thackwell and Christensen (Oct., 1935), and in an article by A. L. Crawford, entitled "Evaluating Gold in Certain Placers by Microscopy," *Mining and Metallurgy* 14, 372 (Sept., 1933). The latter shows a photograph of the small microsplitter. It also includes a discussion of the sampling of spotty and very low-grade gold ores.

material could be split accurately was felt by the Utah Engineering Experiment Station and the Intermountain Station of the United States Bureau of Mines. As a result the "microsplitter," which is essentially a miniature Jones riffle, was developed at the University of Utah by members of the two organizations. In response to a number of requests, plans for two of the most convenient sizes of the microsplitter are shown on page 185, and they are described in detail in succeeding paragraphs.

The microsplitter strikingly proved its worth a number of years ago in a cooperative microscopic investigation carried out by the Utah Engineering Experiment Station and the Bureau of Mines. An extensive study was being made of the ore and mill products of a certain company, and it was found that the microscopic analyses for the copper minerals were not checking at all with the chemical analyses, although the methods used had been tested time and again on other similar ores. The microscopists and the chemists accused each other of being wrong, and matters reached a point where they would hardly speak to one another. Samples were submitted to a chemist not connected with the work, and one of the microscopists secretly ran chemical analyses, but the results were indifferent. Finally the work was repeated with newly prepared samples, and the chemists and microscopists not only again failed to check each other, but they failed to check their own previous results. This rather definitely indicated that the trouble was in the sampling (which had been done in the usual manner), and it was decided to make use of the microsplitter and split the samples all the way down to the amounts needed for the analyses. When this was done all the results agreed beautifully, and harmony again reigned. Since then it has been the practice at the University of Utah to do this in any important analytical or testing work, whether chemical or microscopic. The increased reliability of the results far more than compensates for the small amount of additional time required.

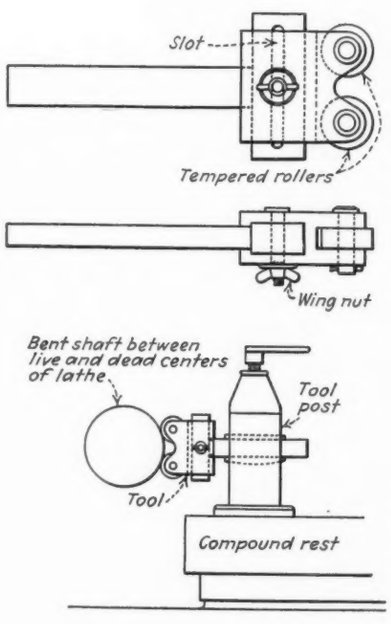
Fig. 1 shows the details of a microsplitter which is particularly useful for cutting down samples for chemical analysis. There are twelve spreaders, which are cut from brass or aluminum plates $2\frac{5}{8} \times 4\frac{3}{8} \times 3/16$ in., as shown in the spreader detail. Aluminum is to be preferred, since brass makes the microsplitter awkwardly heavy. The spreaders are arranged so that their slopes alternate, and are separated by means of eleven thin metal sheets, about 40 gage, each $2\frac{5}{8} \times 4\frac{3}{8}$ in. (see sheet detail). Twelve metal washers, 3/16 in. thick and $\frac{5}{8}$ in. in diameter, are used as spacers, being placed opposite the narrow ends of the spreaders. The two end members are cut from $2\frac{7}{8} \times 5\frac{5}{8} \times 3/16$ in. plates. In addition to forming the legs, they project about an eighth of an inch above the spreaders for convenience in pouring the sample. The assemblage can be fastened together either by five No. 10 bolts or by threaded rods 3 in. long and about 3/16 in. in diameter. The holes in the spreaders, separators, spacers, and end members are drilled to fit the bolts or rods. The scoop is made by cutting, bending, and soldering a piece of sheet metal $3\frac{3}{8} \times 3\frac{1}{2}$ in., to which is then soldered a handle. It is best to make the scoop after the microsplitter is assembled, for it should fit accurately between the end members.

The small microsplitter shown in Fig. 2 was designed for quantitative microscopic work, in which reliable samples consisting of only a few hundred mineral particles are desired. In this device the twelve spreaders are made from brass plates $1 \times 1\frac{1}{2} \times 1/16$ in.; the eleven separators from sheets $1 \times 1\frac{1}{2}$ in.; and the twelve spacers from washers 1/16 in. thick and $\frac{1}{4}$ in. in diameter. The two end members are cut from $1\frac{1}{8} \times 2\frac{1}{4} \times 1/16$-in. plates to form the legs. Next to each of these is an additional plate, cut from 1 x 1 13/16 x 1/16-in. plate. These provide clearance at the bottom and are notched at the top, so that the scoop may be steadied while pouring the very small sample. This microsplitter is fastened together by two No. 4 bolts at the top and two No. 6 bolts below. The scoop is made by cutting and gouging out a piece of 1/16-in. brass as shown.

▼ ▼ ▼

Straightening Tool For Lathe Work

ONE of the most time-consuming and tedious jobs frequently done at the machine or repair shops at mines and smelters is straightening round work, especially shafts and car axles. Usually, this is done in a lathe in the following manner: First, the shaft or axle is placed between the live and dead centers of the lathe and the work is heated to a dull red at the bend by an oxy-acetylene torch or gasolene blow torch while the lathe is running at slow speed. Next, a small jackscrew or a piece of wood is set in the lathe bed just below the bend and by repeatedly applying pressure with the jackscrew or a small steel crowbar the bend is finally ironed out. Light work usually is straightened by a few light hammer blows and without heating.



Andrew Sutherland, foreman in charge of maintenance work at a large lead-silver mine in Northern Mexico, finding the method unsatisfactory because of the time consumed and damage often done to the shaft, solved the problem satisfactorily by employing the roller tool explained in the upper cut. The general set-up shown in the lower cut is relatively simple, and when properly applied work can be rapidly straightened by this method. Care must be taken that the shank of the tool is set parallel with the cross-slide of the lathe and at a height that will bring both rollers to bear equally on work that runs true.

After the tool has been properly adjusted and set exactly opposite the point of maximum bend, the lathe is run at slow speed and both rollers are brought against the work, sufficient pressure being applied to iron out the bend. As soon as the work begins to cool, the pressure is gradually reduced until the rollers barely touch it. The tool proper is made entirely of steel, and consists of a shank with a slotted crosspiece, and a slide containing the tempered rollers. Adjustment of the rollers is easily effected by simply moving the slide up or down and then locking it with the wing nut at the side of the slide.

CAMP of East Mindanao Mining Company at Tinabingan, seen from the mill. The buildings highest up at the left are the staff quarters. In the center at the top is the manager's house. Lower down in right center are the shop, sample crusher, assay office, warehouse and office. The power plant is at the extreme left

Making a Gold Mine In Mindanao

Philippine lode claims, opened from "grass roots," quickly supply 100-ton mill... Costs less than estimate

J. B. Knaebel
Mine Manager,
East Mindanao Mining Company,
Placer, Surigao, Mindanao,
Philippine Islands

GOLD PRODUCTION at the property of the East Mindanao Mining Company in the Philippine Islands began about Sept. 1, 1936. The property is situated at the *barrio* of Tinabingan, at Placer, in Surigao Province, on the northeast coast of Mindanao. The center of operations is close to the beach at Tinabingan, which in turn lies about 1½ km. across a small bay of the sea from Placer. The latter is a municipality situated about 120 nautical miles from Cebu and about 20 km. by water from the town of Surigao.

Little information is available concerning the early mining history of this district other than local legend and some scattered notes in the publications of the Bureau of Science. The local inhabitants have long produced placer gold on a small scale sporadically by panning in the streams. A more pretentious hydraulicking operation in the Cansuran district 15 or 20 km. south of Surigao ended in failure several years ago, but has been revived recently. Exploration of several groups of claims in the area roughly delimited by Surigao, Placer, and Lake Mainit has recently been undertaken by various companies, and some of them seem to have promise.

Apparently, the earliest locator of mining claims at Tinabingan under the American régime was a man named Briggs, who died about 1924. His heirs sold out to W. S. Burwell, who built a ten-stamp mill, which he operated until his money was gone. In September, 1933, the place was visited by Messrs. Hargis and McVean, of Cebu, who, with A. F. Duggleby, consulting engineer of Benguet Consolidated, were returning from a trip south of Placer. While waiting for the tide to turn, Mr. Duggleby inspected the two short tunnels that had been driven on the Briggs vein, and sampled the exposures and some float found in the creek bed near the vein. On Oct. 8, 1933, he reported to Mr. McVean that there might be speculative possibilities in the locality and suggested that if Mr. McVean and his associates were interested in prospecting in Surigao, Tinabingan would be an advantageous base. Thus encouraged, Mr. McVean, with Messrs. Gasser and Hargis, organized the East Mindanao Mining Syndicate to explore the locality, took an option on Mr. Burwell's claims, and engaged the writer of this article to take charge of the work.

Prospecting was actually begun in March, 1934. In the next six months most of the present group of claims were located. Prospecting was carried on as actively as possible with the facilities available. By September, funds were practically exhausted, but the work done had uncovered a number of promising veins. The Briggs vein and the Horseshoe-Pastilan-Mindoro vein (later renamed the Mindoro

vein) had been opened up enough to show that commercial tonnages of ore warranting mill construction might be developed by perhaps a year of further work. The syndicate members thereupon incorporated the East Mindanao Mining Company under Philippine laws in October, 1934. By this time the property had reached the development stage.

The scale of operations was rapidly increased and the staff was enlarged somewhat. Mechanical equipment was bought to permit more rapid work underground. After fourteen months, sufficient ore was developed to justify the erection of a 100-ton cyanide plant.

Meanwhile, metallurgical tests on the ore had been made by E. M. Bagley and E. C. Bitzer, of the Balatoc metallurgical staff, and a preliminary flowsheet had been drawn up. The first 300-hp. unit of a 600-hp. power plant was ordered, and its construction started late in 1935. A contract for building the mill was made with a Manila firm on Jan. 25, 1936, and construction was actively started about the middle of February. All machinery and equipment for the power plant and mill were selected and ordered by the East Mindanao Mining Company on its own account. Both units of the power plant were in operation by Aug. 15 last. Underground development had proceeded uninterruptedly in the meantime, although in the last few months energies had been devoted principally to preparing the mine for actual production.

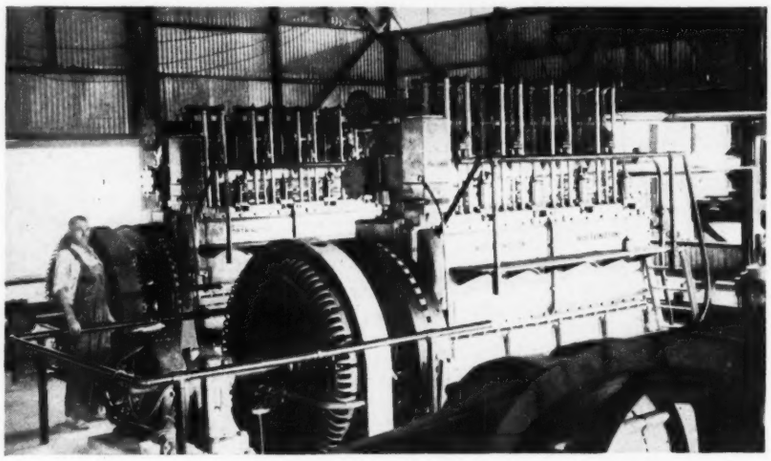
Late in August, 1936, the mill was started up. After some six weeks of the usual minor mechanical difficulties incidental to starting a new plant in a remote district, with green labor, it has operated satisfactorily ever since.

At present the property comprises 44 lode claims and four placer claims. These 48 claims are in one compact block with the exception of a fraction, which is on the near-by island of Dinago and was acquired to furnish a source of limestone for making lime for the mill. Title to these claims is held by the original locators or their assigns, who have granted to the East Mindanao company unencumbered and unrestricted leases for 30 years or more.

Small trading boats from Cebu call at Placer and Tinabingan at irregular intervals. Usually, two or three boats a week carry passengers, freight, and mail. A scheduled weekly boat service connects Cebu and Surigao. From the latter the property may be reached by automobile in about an hour and a half by a good road. The bay is too shallow for close approach of cargo vessels, in consequence of which machinery and heavy supplies are lightered from shipside to the company's wharf at high tide. A government post office at Placer provides mail and telegraphic facilities by which messages may be sent to Surigao, Cebu, and Manila.

In this region there are two fairly distinct seasonal variations corresponding with the monsoon periods. During the northeast monsoon, from November to March or April, there is much rain and occasionally storms lasting days, with very heavy precipitation. During the period of the company's operations the worst storm lasted about eighteen hours, during the last ten of which more than 12 in. of rain fell. Destructive typhoons, however, nearly always pass to the north of Surigao Province. From March to November there is much less rain and little interference with mining operations need be feared. As a rule, the temperature varies between 70 and 90 deg. F. and the humidity is relatively high.

The property lies close to the sea-



IN THE POWER PLANT. Two 300-hp. Worthington diesel engines are direct-connected to two 200-kw. General Electric generators operating at 480 volts. At the left is J. C. Thomson, master mechanic

coast and the terrain is in general steep and hilly. Deep erosion has resulted in a mature physiography. Elevations above sea level are moderate, the highest point on the property being less than 700 ft. above the sea. Numerous small streams drain the area, two of them passing through flat swampy ground before reaching the sea.

Parts of the property are covered with heavy tropical forest composed mostly of red and white *lawa-an, tanguile* (Philippine mahogany) and various other species. Mangroves (*pagatpat, bacao*) are abundant in the inter-tidal areas. Other parts of the property were logged off years ago, and are now grown over with dense rank grass (*tigbao*), wild bananas, and a diversity of second-growth thorny shrubs, vines, and the like. The vegetation combines with deep weathering to increase the difficulties of prospecting.

Domestic water sufficient for camp use and for the development plant is pumped from Tinabingan Creek to a 3,000-gal. redwood tank on the hill above the mine office. This source will continue to be used for future domestic and camp requirements.

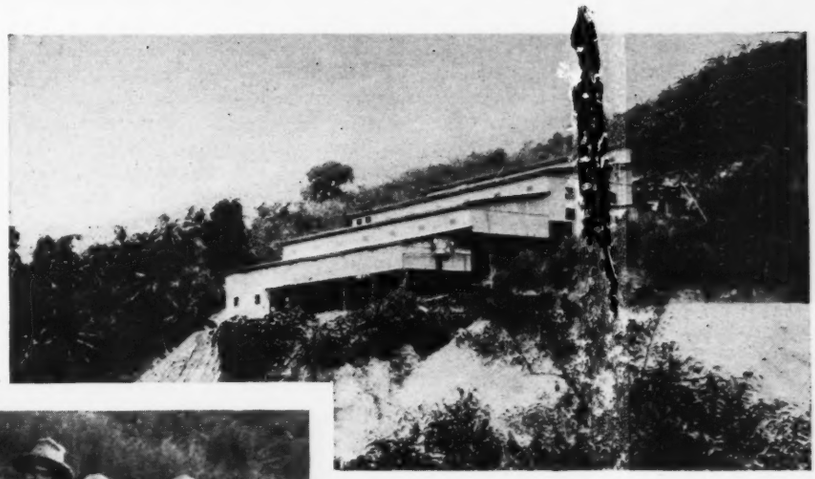
Water required in milling is derived from the underground workings on the Mindoro vein. At present the flow is approximately 150 g. p. m. This water has been analyzed and found to be well suited to the requirements of the cyanide plant.

Sawed lumber for mining and construction purposes is obtainable from small sawmills situated at Surigao and Lake Mainit. *Yacal* is largely used for timbering the mine drifts, shafts, raises, or other openings that must be held upon for a period of years, but inferior timber, such as *lawa-an* and *pagatpat*, is entirely suitable for use in the stopes. The company holds miners' timber licenses covering a fairly heavy stand of red *lawa-an*, white *lawa-an* and other timber. The supply of such timber on the company's own property will probably be more than ample to meet its needs for stope timbers for many years.

Gravel of good quality is not available locally for concrete construction, and in consequence fresh andesite rock has been quarried about 3 km. from the millsite, transported to the work in trucks, and crushed in a rock crusher to produce coarse concrete aggregate. Sand has been obtained from the mouth of a stream about 2 km. from Placer and transported to the site in the company's 60-ton lighter. This sand was excavated from public lands by license. Lumber for construction has been obtained largely from the sawmill at Surigao previously mentioned. Cement and all other construction materials and supplies are shipped in from Cebu or Manila.

Labor locally available consisted three years ago almost entirely of

Visayans living in the locality. Recently, however, there has been a notable influx of Visayans from Leyte, Bohol, Samar, and Cebu. In the early stages of operations labor was periodically hard to get during planting and harvesting, but since the company has built adequate houses for laborers and their families, this scarcity has been felt less. On the whole, the efficiency of the local labor is rather low, and the output of a man in units of work is much less than with the Igorot and Ilocano workers of the Baguio district. Therefore, it is not surprising



THE CYANIDE PLANT, of 100 tons' capacity. Save for the crushing plant, it is seen complete. Erection was begun in the middle of February, 1936, and the mill was running by the latter part of August

VISAYAN MINERS, native to the district. Save for spasmodic panning of local gravels for gold, these men knew nothing of mining, especially of lode mining, and have had to be trained by the company

that the local wage scale is considerably lower than in the northern mining districts in the Philippines. When the property was opened in 1934 the prevailing maximum wage rate in this province was 20 to 30 *centavos* per day for unskilled labor. The present basic wage scale of the East Mindanao company ranges from 50 *centavos* for unskilled labor to several pesos for certain more or less skilled classifications. All employees receive a daily ration of one liter of uncooked rice.

When exploration work began, difficulty was experienced because of the high turnover of labor. This condition was largely overcome by instituting an attendance bonus, whereby every man who is present on every working day during the pay period of two weeks receives 10 *centavos* per day in addition to his base wages. Should he miss one day for any cause other than injury sustained while at work, he loses this bonus for the entire period. This has reduced the labor turnover from about 200 per cent to less than 10 per cent.

At the start of the work it was impossible to secure experienced labor. The local inhabitants were all farmers or fishermen. It was necessary to train the workers from the very beginning, with results that at least have permitted the conduct of operations at a reasonable cost.

During the past three years the company has constructed two *barrios* for the laborers and their families, consisting altogether of 57 houses of light construction. An adequate supply of domestic water is furnished and an effort is made to maintain sanitary conditions as satisfactorily as possible. As mentioned before, all workers are given a daily ration of rice. Several native stores, or *tiendas*, are located in the two *barrios*. The company itself does not maintain a store or commissary, these facilities being available in Placer. The company has never desired to compete with local merchants. A staff house for bachelors and four family residences have been built for staff members.

A dispensary equipped with a small ward having two beds and facilities for emergency surgical operations is maintained. A physician spends two days a week at the mine and is subject to call in emergency. All employees are examined before or soon after being employed. Injections recommended by the Bureau of Health are given to employees and their families to afford protection against cholera, dysentery, and typhoid. Medical assistance is available to all members of the community at no cost, except for medicine.

Geology—The rocks exposed on this property are almost entirely of igneous origin. The coastal limestone is not known near the veins, although it outcrops at the northwest corner of the property and, of course, on the company's limestone claim on a near-by island. Much of the surface consists of andesitic extrusives, associated with more acid flows and on part of the property, with a sedimentary conglomerate composed principally of andesitic fragments but containing also limestone pebbles.

Diorite porphyry outcrops on Cog Point and comprises most of the surface south and southwest of the Mindoro vein. Wherever it has been possible to observe the relations of this rock with other formations, it is generally in contact with extrusive andesite.

Deep soil erosion and surface weathering effects have obscured the surface geology, and have added measurably to prospecting difficulties. Most of the local formations being essentially andesitic, they all weather to a deep, highly colored clay that gives little clues to the genetic character of the underlying solid rock, other than that it is probably andesitic.

The veins are clearly of the epithermal, or low-temperature, type. They have been formed by silicification of the walls of relatively tight fractures in the country rock, with more or less complete replacement by quartz extending a few inches to several feet into the walls. Locally in the veins open fissures of restricted extent have been filled with quartz of the "open-cavity" type. Pyrite and gold were deposited with the quartz, probably during the later stages of silicification.

Much later, geologically, erosion and

deep weathering attacked the upper parts of the veins, altered some of the pyrite to iron oxide (limonite), and induced a downward migration of gold—by mechanical and probably also chemical processes, since some manganese is present—that more or less kept pace with the lowering of the vein outcrops by erosion.

A consequence of this secondary enrichment of great practical significance is that the secondary values are highly erratic in distribution, and in some cases are found in the soft walls of the veins rather than in the veins themselves.

The Mindoro vein, which is the most important, occupies a shear zone in andesite, or possibly diorite, porphyry. It is a siliceous replacement of the andesite, with bands and ribs of hard quartz along the stronger fractures carrying most of the gold.

Structurally, some of the veins are related to formational contacts. The Tinupan vein is on a contact between fragmental extrusive andesite and another fragmental rock of the same general character but of probably sedimentary origin, as evidenced by the occasional presence of pebbles.

Number Four vein lies in fragmental andesite close to a contact, and the apparent end of the oreshoot is at the junction of the vein fracture with the sedimentary conglomerate. The Briggs vein also lies wholly within the fragmental andesite, but is close to the southern contact of this rock with the diorite porphyry or the intrusive andesite.

The Cloudburst vein differs from the three veins just mentioned in that it lies wholly within the porphyry, south of the Mindoro vein. It contains good ore over 2 to 4 ft. widths, but is not expected to persist downward, because it is not contained in a persistent fracture or shear zone. It was deposited in a tension fracture in the porphyry which will almost certainly be local in extent.

An interesting feature is a tendency of the ore to be stronger on one strike than on another strike that differs from the first by only a few degrees. This is due to the fractures being more open in the first direction and tighter, or squeezed, in the second.

All of the veins except one dip at steep angles—usually nearly vertical—to the southeast, and all of them strike southwesterly to west. The Tinupan vein, however, dips steeply northwest.

In general, the veins have relatively narrow to moderate widths. Commercial widths so far encountered vary from 3 to 9 ft. except that the central part of the Mindoro Shaft orebody is more than 25 ft. wide in places. The weighted average width of the two principal veins is found to be 5.8 ft.

Development of the Mindoro vein has reached a maximum depth of 400 ft. below the collar of the Mindoro shaft, and the drift on the 400-ft. level is approximately 40 ft. below sea level. The lateral extent of the known ore in the Mindoro vein reaches its maximum on the 300 or main haulage adit level, where the combined length of commercial oreshoots aggregates approximately 775 ft. The Briggs vein oreshoot has been ıp throughout a length of more than 400 ft. on the Burwell Tunnel level, which is about 150 ft. below the vein apex and 40 ft. above sea level. A winze 67 ft. deep has shown continued downward extension of ore to at least 27 ft. below sea level.

The bottom levels of the workings on both of the principal veins exhibit geological evidence of further persistence in depth.

Reserves Estimated Conservatively

No other property having operated in the district within modern times, there was no yardstick for qualifying and modifying estimates of ore reserves, recoveries, and production costs. It was therefore necessary to be extremely conservative in evaluating assays, particularly of high-grade samples. Similar caution was called for in the matter of commercial stoping widths. A consistently "cold-blooded" attitude has been maintained in sampling and in calculating ore reserves.

Present estimates of ore in reserve are based upon the results of several thousand samples. All underground development workings at this property are systematically sampled by unusually large channel cuts taken across the vein at regular intervals along the vein strike; in most cases the sample interval is 5 ft. These samples are cut with hammer and moil in sections across the exposed faces in such a way that individual bands of ore and waste are sampled individually. Since the gold is rather erratic in its distribution within the vein, large samples of uniform width and depth are taken to offset as far as possible these inequalities. Whenever samples give excessively high assays, check samples along the same channels are taken underground before the assay results are considered in the estimates.

In calculating the tonnage and grade of ore developed an absolutely impartial and recognized method of geometric averaging is used which gives a result in which each sample carries a mathematically correct weight. In other words, each sample influences the final result in geometric proportion to the width of ore and strike length of the individual exposure that the sample represents.

Before the calculation of reserves is undertaken every sample that represents a vein width narrower than could be mined in practice is recalculated, or "diluted," to a full mining width. For example, should a sample of the vein represent a width of only 12 in. of ore, with the samples of wall rock material on each side assaying below commercial grade, the width of the sample is geometrically averaged with nt width of barren waste to allow for the amount of such waste that will inevitably have to be mined with the ore after operations have commenced.

In determining the minimum mining width in each ore block the probable method of stoping is taken into careful consideration. Thus in a few cases where the wall rocks are firm enough to stand well, it is possible to mine at a relatively narrow stoping width. Certain portions of the Briggs vein can be mined by the cut-and-fill method of stoping, which will permit a minimum mining width of 30 in. In a few cases involving relatively a small proportion of the total estimated tonnage, this minimum width has been employed in the estimates. In a few other cases a width of 36 in. has been adopted, but in most of the ore blocks minimum stoping widths of 50 and 60 in. have been taken as conservative mining widths. Probably 90 per cent of the ore included in the estimates has been calculated over this minimum mining width of 4 to 5 ft.

In addition to assay maps and sections, detailed structural maps of the geology have been prepared by careful geologic mapping underground, and these have been invaluable as adjuncts to the assay map data in calculating the ore reserves. The peculiar character of the geological structure of the Mindoro vein, especially in the F Block above the 200 level, has called for the exercise of painstaking judgment based upon an intimate knowledge of the local orebodies in arriving at correct estimates of tonnage and grade. In this particular part of the mine a conservative engineering policy has necessitated some deviations from the conventional mathematical methods of estimation, and the local structure and characteristics of the mineralization have been given considerable weight.

Various blocks of ore have been classified as developed, probable, and possible. This classification follows more or less the usual conservative rule of thumb regarding the definitions of developed, probable, and possible ore, although in some cases geologic considerations have been of sufficient importance to require some revision of the usual definitions. In general, developed ore is ore that is exposed on three or four sides by development workings or surface exposures; in the

(*Continued on page 193*)

Blasting Accidents

Can Be Eliminated

II. Losing light while spitting fuses . . . Shooting at the same time in two faces that are about to connect . . . Returning too soon . . . Drilling or picking into a missed hole

Thomas Soule
Chief Engineer,
Industrial Indemnity Exchange
San Francisco, Calif.

W. J. Williams
Safety Engineer,
Phelps Dodge Corporation
Morenci Branch, Arizona

SIX typical mishaps in blasting were cited in the first installment of this article, published in the March issue. Their possible causes were analyzed and ways of avoiding them were suggested. These mishaps were: I, Firing the charge while it is being loaded. II, Premature explosion of the charge. III, Staying too long at the face when spitting. IV, Unguarded shot. V, Struck with flying rock. VI, Injury by concussion. Five other typical accidents are dealt with in the following:

TYPES OF ACCIDENTS

VII

Losing Light While Spitting Round

▶ Possible Causes:

1 Dropping lamp down a raise.
2 Dropping lamp in a chute.
3 Insufficient carbide or water.
4 No lighter on lamp or no dry matches.
5 Fuse spitting into flame of lamp, extinguishing the flame.
6 Rock falling on the miner or on the miner's lamp while he is spitting.
7 No partner with a lamp in reserve.

▶ Suggested Preventative:

FUSE BLASTING: One man must never spit a round of holes by himself. A second man must always be present in the face if a drift round is being spit, or at the bottom of the raise if it is a raise that is being spit. It is the duty of the second man to give the first man a light in case of emergency.

Both men responsible for spitting should check their lamps just before spitting to see that they have plenty of carbide and water, that the burners are clear, and that the flint lighters are in good order. Both must be provided with dry matches. It is possible to spit without the use of the miner's own lamp. An extra lamp can be provided for this purpose. There is a patented lead fuse on the market that can be used for a spitter, and a notched section of safety fuse is often used.

It is important to see that the back is thoroughly dressed down after the round is drilled. This is especially important where a drill column has been used, inasmuch as the vibration of the drill may have loosened some rock in the back. Such rock has been known to fall on a miner's lamp and even on the miner himself while he was spitting.

ELECTRIC BLASTING: This method of blasting eliminates all hazards of fuse-spitting, as all of the spitting in electric firing is done from a safe place out of direct line of fire from the face.

VIII

Blasting Simultaneously Two Faces That Are About to Connect, and One Face Going Off Before the Men in the Other Are Clear

▶Possible Cause:

1 Charge from one face setting off the charge in the other face.
2 Mistake in measurement.
3 Loading one face while drilling is still going on in the other.
4 Mistake on the part of the men doing the spitting in arranging the time to spit.
5 Spitting after having compared timepieces and one or more watches proving defective.
6 One miner becoming panic-stricken from fright or nervousness and spitting too soon.
7 Spitting two approaching faces by prearranged signals and failure to get or misunderstanding the signals.

▶ Suggested Preventative:

FUSE BLASTING: First of all, whenever two faces come within 20 ft. of connection, all work should be stopped in one face, and that face should be exposed and inspected for missed holes. Work should then be pursued from the other face until the connection is completed. If in doubt as to the measurement between two approaching faces, or if it is suspected that the engineers have made a mistake, call upon the engineers to recalculate the distance to go for connection.

Whenever two faces are being driven for connection, regardless of the distance they are apart, one of them should never be loaded while drilling is going on in the other. There is danger of drilling into a hole that is being charged. It is poor practice for two men to set their watches together and then spit at a predetermined time. The ordinary miner's watch is none too reliable. It is better to spit one face at a time while the other is guarded.

When rounds have been drilled in two connecting faces, load and shoot one round; then load and shoot the other. For example: If both rounds have bottomed near the same plane,

holes firing in one face may set off holes from the opposite face, thereby spoiling the round of the second face through cut-off fuses or through having a hole in the opposite face firing out of turn.

The use of signals, such as pounding of two faces, is unreliable, as a foreign sound similar to that of the prearranged signal may be mistaken for it.

ELECTRIC BLASTING: All men can be checked out of the blasting area before either round is spit. If the entrances to both headings are so situated, both can be shot simultaneously, all men being out of both before the rounds are fired.

IX . . . *Returning to the Face Too Soon*

▶ Possible Causes:

1 The blaster hearing another shot and thinking it was his own.
2 Miscounting, when counting shots.
3 Hang-fire or burning hole.
4 Not waiting at least half an hour after shots go off before returning.

▶ Suggested Preventative:

FUSE BLASTING: A person placed to guard a shot should never leave his post until released by the person who put him there. It is poor practice to count shots for reporting missed holes. This may seem like a radical departure from traditional safe practices; nevertheless, such counting is unsafe. Tests have shown that where a group of men are counting shots independently, there will be a difference as to the count. With the standard "V"-cut round, the cut holes *may* or *may* not go together, thus making the best of counting inaccurate.

Never return to a face where more than one shot has been fired within half an hour from the time the last report was heard. When so returning always assume that there is a missed hole until you have proved otherwise. Meanwhile, pursue any work at the face accordingly.

ELECTRIC BLASTING: In electric blasting, the miner or boss doing the blasting will know whether or not the reports he hears are his own shots, because the shots will fire at the time he throws in the blasting switch or pushes down the plunger of the blasting machine.

There is less danger from a hang-fire with electric blasting, as the fuses used are very short. With the metallic delay blasting cap, this danger is practically eliminated.

Probably there is more danger of setting powder on fire with electric blasting than with fuse blasting. That is, untrained miners may think the longer the power switch is held in, the better the explosion will be. Holding the power switch in after the detonators have ignited may heat up the leg wires and thus ignite the dynamite.

In electric blasting, it is best to have the boss actually fire all rounds, or delegate this to specially trained miners.

X . . . *Drilling Into a Missed Hole*

▶ Possible Causes:

1 Face not properly inspected before starting to drill.
2 Drilling from a set-up on top of a muck pile before the face has been entirely exposed and inspected.
3 Drilling for a connection and drilling into a missed hole in the opposite face.
4 Face plastered with mud.
5 Hole squeezed shut by swelling ground.
6 Collar of missed hole below water level.
7 Explosives in boulder that is being drilled preparatory to plug-holing.
8 Drilling a new hole alongside a missed hole and misjudging the direction.
9 Drilling into bootlegs or bottoms containing explosives.

▶ Suggested Preventative:

FUSE BLASTING: No drilling should ever be done in any face until it has been entirely exposed and examined for missed holes. This prevents the so-called drilling off of the muck pile. Whenever two faces are within 20 ft. of connection, no drilling should be done in either until the opposite face has been entirely exposed and thoroughly inspected for missed holes.

Clean or wash down all muddy faces and examine closely for missed or cut-off holes. Thoroughly clean out and examine all bootlegs or bottoms for unexploded powder, and under no circumstances do any drilling in them, as the explosives may have been driven into the crevices around them.

All holes should be bottomed, so far as possible, in the same plane, especially in squeezing ground. If some holes are drilled deeper than others, their bottoms may be squeezed shut, confining the explosive so that it cannot be seen on superficial examination.

Be unusually suspicious of an irregular face. Such a face in a heading that has been correctly drilled and shot will usually indicate a missed or a cut-off hole.

Make a special examination for missed lifters. Remember that a lifter when drilled soon passes below the level of the drift floor.

Before drilling in the face, always shoot missed holes by repriming with a new primer. If it is difficult to insert a new primer, the hole may be shot by placing a plaster shot against it. Do not attempt to *dig* out the explosive from a missed or cut-off hole.

Never drill alongside a missed hole for the purpose of shooting it. There is danger of drilling into it.

Before drilling a boulder, thoroughly inspect it on all sides for holes that might contain explosives.

ELECTRIC BLASTING: All rules pertaining to missed holes with fuse blasting should be followed with electric blasting. All things being equal, fewer missed holes should be had with electric blasting than with fuse. Many missed holes resulting from fuse-blasting are really cut-off holes; that is, the fuse is severed before it has burned to the cap. With the safety primer, the primer is placed in the bottom of the hole, and even though the leg wires are severed while the holes are firing, no explosive will be left in a cut-off hole, as all electric detonators are ignited at the same time and therefore all of the explosive left in the hole with the primer will be exploded.

XI

Picking Into a Missed Hole

▶ Possible Causes:

1 Primer placed too near collar.
2 Entire hole cut off except primer.
3 Picking into missed hole in high bottom.
4 Striking against face with pick before or while examining for missed holes.

▶ Suggested Preventative:

FUSE BLASTING: In fuse blasting, the best location for a primer is the second stick from the bottom. Having one stick of dynamite in the bottom cushions the primer, thus preventing the blasting cap from coming into contact with the bottom of the hole. It also gets the primer away from the collar of the hole, where there is danger of picking into it.

In reloading and reshooting a hole, it is usually necessary to place the primer near the collar. In this case, the oncoming shift must be particularly warned against picking around the face.

When looking for missed holes or in loosening up the muck pile, the pick should be used with a raking or hoeing motion only.

When plugging out in the bottom of a drift to bring it to a grade, such holes must be shot independently of the face. If they are shot with the face round and miss, the broken rock from the face will cover such holes and the mucker in cleaning up the face round is almost certain to pick into them.

When it is necessary to take down slabs from a face where missed holes are suspected, one should proceed cautiously, using the pick or bar as a pry only, and under no circumstances should the face be struck a blow with any pick, bar, hammer, or other tool.

ELECTRIC BLASTING: When electric blasting and safety primer are used, the primer is always placed in the bottom of the hole, so that it is protected from blows from bar or pick, unless all of the hole is cut off except the last three or four inches. Also, the blasting cap in a safety primer, being almost entirely inclosed in a block of wood, is well protected.

(To be concluded)

Making a Gold Mine in Mindanao

(Continued from page 190)

case of the upper levels of the Mindoro vein, in the F block, where the lateral workings are only 50 ft. apart vertically and the vein has been systematically crosscut at close intervals, the ore bounded by drifts and crosscuts between the 100-ft. level, the 50-ft. level, and the surface is regarded as fully developed ore. Probable ore is ore exposed on two sides by underground workings or by underground workings beneath and surface exposures above. Possible ore is ore exposed on one side only by underground workings. In no case is any ore included in the estimates below the lowest development on the various veins, and probable ore is never assumed to extend for more than 25 ft. beyond an actual underground exposure.

Tonnage factors used in the estimates have been determined by careful measurements and weights. In several representative places underground, accurately measured volumes of the ore were cut with moil and hammer, and weighed. As a result of this special sampling two tonnage factors have been arrived at; a factor of 15½ cu. ft. per ton has been used for certain blocks of completely oxidized ore, and one of 15 cu. ft. per ton for the remaining partly oxidized and unoxidized sections.

Stoping operations have confirmed the reliability of the methods of sampling and estimation of ore reserves. The average grade of ore sent to the mill has been somewhat higher than the estimated figure, despite the inclusion in the mill feed of a substantial proportion of lower-grade material from development dumps. The average stoping width has normally been greater than it was possible conservatively to estimate on the basis of the original development; this is due to the occurrence of erratic values in the vein walls and of short tongues of ore branching off into the walls along minor fractures of limited extent. To have developed these tributary sources of ore fully would have entailed an unreasonably high development expense. The present policy is to prospect these possibilities by various methods such as small crosscuts and stope-slabbing operations concurrently with stoping.

In all probability the fact that the ore as mined is running somewhat above estimated grade is due in part to the rather frequent occurrence of small rich pockets which for reasons of safety had to be discounted in the original estimates made before actual operation results were available as a check, and in part to the fact that wall-rock dilution in stoping is not composed of barren material but, on the contrary, carries low values which more or less balance the cost of mucking and tramming the extra tonnage involved. In other words, it is in this case economically profitable to mine a great width of ore at some sacrifice in grade, rather than to attempt to carry narrower stopes on the richer sections with attendant increased expense of the close timbering that would be required to prevent sloughing of low grade ore from the soft hanging wall. Furthermore, carrying narrow stopes would result in passing by many small lenses and patches of good ore that lie blind close to the main ore channel.

For various reasons involving such things as the political situation, general economic conditions, and the company's financial resources, a general policy was adopted looking to the erection of a mill as soon as enough ore had been developed to repay the cost of the plant out of production profits, with the idea that dividends must come from additional ore opened up by development work done during mill construction and afterward.

By the end of 1935 enough ore had been developed to repay the production cost, with an operating profit large enough to defray the cost of plant construction. Further delay would have resulted in tying up more capital and perhaps ultimately compelling the company to seek outside financial assistance, with loss of control of its property. Moreover, with such a tonnage of ore the company could not conceivably abandon a project from which the capital already invested could at the least be recovered by building and operating a plant. It was therefore determined to proceed at once with construction.

Development continued during construction. According to the semiannual estimate of May, 1935, the tonnage and grade of ore in the principal veins at that time were as given in Table I.

By Oct. 31, 1936, after more than two months of mining (from the Mindoro vein only) and milling, supplemented by detailed records of individual stopes, had given a basis for testing the accuracy of the original estimates, it had become apparent that the grade of ore over the widths estimated was somewhat higher than that estimated; in other words, it was possible to mine across substantially wider stoping widths, thus increasing the tonnage, without lowering the grade of the millheads below the estimated grade. This had the further pleasant effect of lowering stoping costs and increasing ore reserves. Reserves were also substantially augmented by the results of continued development. Total reserves at the time of starting the mill were conservatively taken to be 100,000 tons having a grade of 22 pesos per ton. No difficulty is anticipated in keeping millheads at this grade.

(To be continued)

Table I—Tonnage and Grade of Ore Developed, May, 1936

Vein	Developed Ore		Probable Ore		Possible Ore		Total	
	Tons	Grade(a)	Tons	Grade(a)	Tons	Grade(a)	Tons	Grade(a)
Briggs	4,250	.....	5,110	.....	.....	.....	9,360	24.13
Mindoro	55,050	.....	12,900	.....	1,560	.....	69,510	22.03
Tinupan	.....	.....	1,340	.....	.....	.....	1,340	18.69
No. 4	.....	.....	.....	.....	1,000	.....	1,000	21.00
Cloudburst	.....	.....	.....	.....	1,000	.....	1,000	28.00
Total	59,300	21.26	19,350	25.97	3,560	19.11	82,210	22.33
	On Dumps (from original development)		Tons 7,300	Grade 12.46				

(a) Grade is given in pesos at the current price of 70 pesos per ounce.

Survey Control of

The "Projector Method" Developed At the Idaho-Maryland Mine

Rollin Farmin [1]

Glenn C. Waterman

and

Allan James

SMOOTHLY curved crosscuts are needed at several places on every main level in mines using motor haulage where crosscuts are swung into the hanging wall or foot wall from drifts on the vein and where crosscuts lead away from shaft stations. Uniform curves of 40-ft. radius have been adopted at the Idaho-Maryland mine for the operating advantage of using standardized switches and timber, and for the economy of better haulage.

Few miners drive satisfactory curved crosscuts "by eye," and frequently survey control cannot be dispensed with because the crosscut must arrive at a definite terminal line or terminal point. Customary surveying practice for control of curves has objectionable features. It entails laborious drilling of many holes in the roof to support line spads and necessitates undesirable field calculations. Because the advance of the heading with each successive round of blasting is variable, the series of sighting spads placed to furnish control of the successive faces is based on guesswork. Furthermore, the surveyor is never certain the miners will select the proper pair of line spads unless he visits the heading every round to check the line-up.

The curve projector, here described, was devised by the writers of this article to reduce the work of the surveyor and to give him better control of the curved crosscut with fewer trips of inspection. For a 60-ft. crosscut, curved through 90 deg. of arc, he now makes two or three trips to the heading and places a total of either six or nine control spads in the roof.

The projector, Fig. 1, is made from a folded 3-ft. strip of sheet metal. A series of sharp notches is cut in the short, upturned edge of the strip to hold the knotted plummet string which is used as a rear sight for aligning the crosscut. The front sighting plummet is hung from a spad in the roof at point of curve (Fig. 2). Six feet behind the front spad the projector strip is hung by wires from two spads placed approximately at right angles to the tangent line. The two holes in the strip by which it is hung are punched in the field so that the strip will hang with the notch numbered "0" on tangent line. By offsetting the rear plummet to successive notches 1, 2, 3, . . . 30, the lines obtained by sighting from it across the front plummet give the correct center of face of the curved crosscut at successive points 1, 2, 3, ... 30 ft. ahead of the front plummet. For a left-hand curve the notch numbers read from left to right; by reversing its ends the same strip can be used for a right-hand curve.

The projector strip is trimmed, bent, and notched as shown in Fig. 1. Offsets from zero notch to every tenth notch are given in the table. Intermediate notches are spaced apart equally. A generalized equation, based on Fig. 3, for computing offsets from the zero notch on the projector follows:

$$O = S \tan A \text{ and } \sin A = \frac{C}{2R}$$

Notch numbers and directions for operation of the projector are painted on the face of the strip in bright paint.

Selection of the tangent line and point of curve from which the new curve will start is made by the engineer who has planned the development, either in the field or in the office. After the surveyor has placed the spad at point of curve and the two spads for support of the projector strip, he carefully demonstrates the operation of aligning the crosscut to the miner. The simple directions on the strip will keep the miner from forgetting how to use it. The shift boss is likewise in-

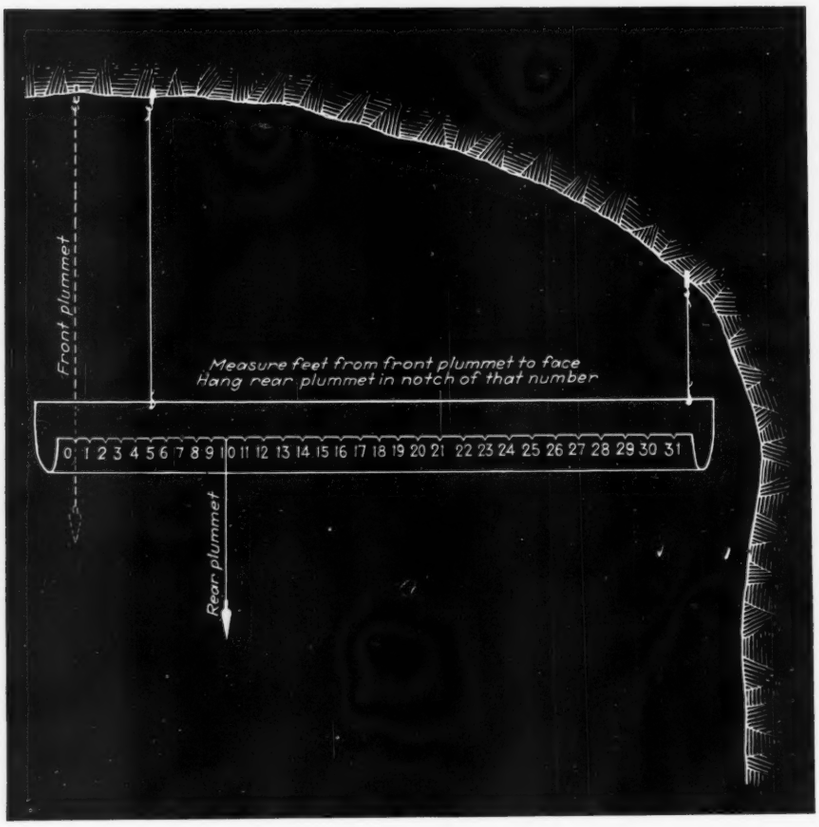

Front plummet
Measure feet from front plummet to face
Hang rear plummet in notch of that number
0 1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19 20 21 22 23 24 25 26 27 28 29 30 31
Rear plummet

Fig. 1 . . . PROJECTOR and sighting plummets hanging in place from roof of crosscut

[1] Respectively chief engineer and geologist; geologist, and engineer, Idaho-Maryland Mines Corporation, Grass Valley, Calif.

Curved Crosscuts

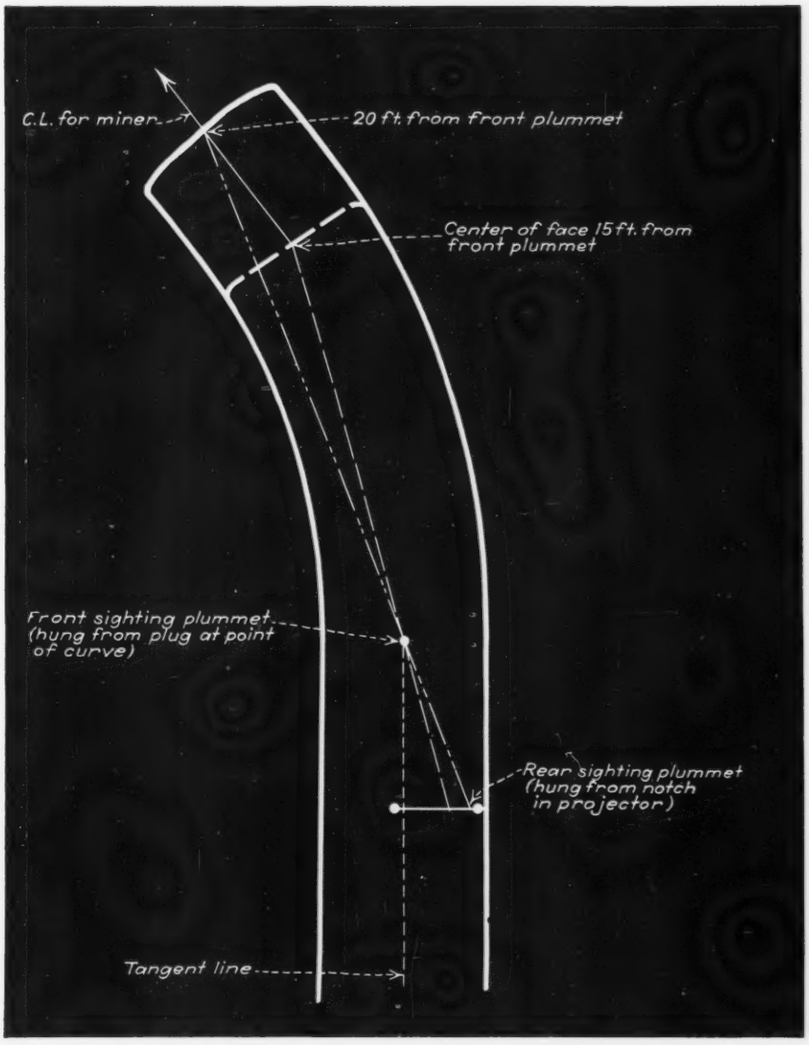

C.L. for miner
20 ft. from front plummet
Center of face 15 ft. from front plummet
Front sighting plummet (hung from plug at point of curve)
Rear sighting plummet (hung from notch in projector)
Tangent line

Fig. 2 . . . CURVED CROSSCUT in plan, showing method of centering face and aligning new round

structed in its use and he checks the alignment for drilling each round and notifies the surveyor of the progress of the crosscut.

The miner aligns his round as follows: He measures the distance in feet from the front plummet to the face of the crosscut and hangs the rear plummet from the projector notch bearing that same number. He then sights from the rear plummet across the front plummet to the face and marks on it the correct center of the crosscut (a point on curve). If he wants to know the direction to point his next round of holes, he can measure and mark another point on curve five feet back from the face—the line between the two center points gives him the approximate direction for the new round. The projector can also be used in bending and aligning track, the center of which can be marked at short intervals.

A standard curved crosscut can be advanced about 30 ft. ahead of the front plummet before the side wall blocks the line of sight, and then the projector must be moved nearer to the working face. The new spads can be placed with transit if a check of the control is desired, but usually the transit is not needed and points for the new control spads can be established as follows: Two points on curve are located—one the correct center of face of the crosscut and the other the point from which the new front plummet is hung, about 5 ft. behind the face. The projector strip is then moved forward to its customary position, 6 ft. behind the front plummet, where it is hung so that the appropriate footage notch lies on line with the previously marked center of face and the new front plummet. No serious loss of accuracy is involved in this method and a transit survey can be deferred until the crosscut has reached its final bearing and "straight-ahead" spads are to be placed.

Offsets on Projector

For Points on Several Curves — Plummet Spacing 6 Ft

Chord Length in Feet	Radius — Feet					
	20	30	40	60	80	100
6	0.90	0.60	0.45	0.30	0.22	0.18
10	1.35	1.10	0.76	0.50	0.38	0.30
20	3.46	2.12	1.55	1.01	0.76	0.60
30	....	3.46	2.42	1.55	1.14	0.91
40	....	....	3.46	2.12	1.55	1.23
50	....	....	....	....	1.97	1.55
60	....	offsets in feet		....	....	1.89

For different spacing "S" multiply offset by $\frac{S}{6}$

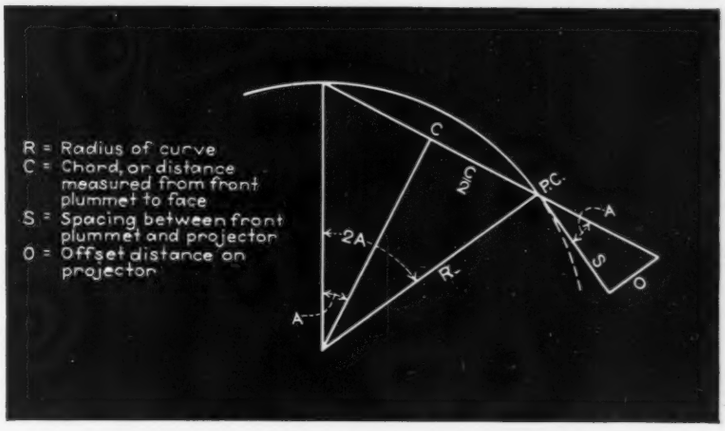


Fig. 3 . . . OFFSETS can be computed from this diagram

Fig. 1—THE MODDER DEEP type of injector —long used on the Rand

Fig. 2—A CYLINDRICAL INJECTOR—the simplest type

The Air Injector

For Auxiliary Ventilation Underground

Walter S. Weeks
Professor of Mining, University of California, Berkeley, Calif.

Mr. Weeks discusses:

1

A method of predicting with sufficient accuracy the pressure-volume characteristics of two types of air injectors for auxiliary ventilation

2

Design of the compressed-air nozzle and behavior of the jet after it leaves the nozzle

• *He demonstrates the marked superiority of a Venturi type of injector, and shows how to design it to meet specific conditions of pressure and rate of flow*

FOR MANY YEARS a type of air injector has been in use on the Rand, in South Africa[1], for auxiliary ventilation underground, and it is now employed in this country also. It is shown in Fig. 1, and is in essence a Venturi tube into the throat of which is injected a stream of compressed air from a nozzle. An injector similar to the one illustrated was tested about ten years ago by Weeks and Lury[2] and found to have a pressure-volume characteristic similar to that of a centrifugal fan.

More recently at the University of California tests on injectors have been made under the direction of the author of this article, by J. J. Strutzel, R. A. Lindblom, and F. T. Johnson, and from their results it has been possible to formulate a workable theory for designing an injector and predicting its behavior. Before discussing the action of the injector a study of certain physical principles that will be involved is necessary.

The Momentum of an Air Stream—Momentum is mass times velocity. In the case of a fluid stream the mass used is the mass per unit of time, so the momentum is really the momentum per unit of time. In this paper "momentum per second" will always be used, but for the sake of brevity it will be called "momentum."

The expression for momentum is then

$$M = \frac{Wv}{g}$$

M = Momentum
W = Weight per second flowing
v = Velocity in ft. per sec.
g = Acceleration due to gravity

The rise in pressure that takes place in the injector is calculated in two ways, depending on conditions. The two ways may be designated as "abrupt" and "gradual" change of momentum.

Abrupt Change in Momentum—Consider a fast stream with velocity v_1 entering a large duct and slowing down to v_2 with turbulence. Consider a small weight of air Δw. This is slowed down from v_1 to v_2 in a time Δt. The force that must be exerted from the right toward the left to accomplish this is

$$F = \frac{\Delta w}{g} \times \frac{v_1 - v_2}{\Delta t}$$

If the flow is steady $\frac{\Delta w}{\Delta t}$ must be the rate of flow W and so

$$F = \frac{W (v_1 - v_2)}{g}$$

If we isolate the turbulent section as shown in Fig. 3 by the planes $A - A$ and $B - B$, the forces in this section must be in equilibrium with steady flow.

Let P_1 and P_2 be the unit pressures at the planes, in lb. per sq.ft. and A be the area of the large duct in sq.ft.

Then considering Fig. 3—

$$P_1 A + \frac{W (v_1 - v_2)}{g} = P_2 A$$

$$P_2 - P_1 = \frac{W (v_1 - v_2)}{A g}$$

This shows that when a stream slows down abruptly in this manner the rise in pressure is equal to the change of momentum divided by the area of the duct. This momentum theorem can be applied only when the two ends of the isolated section are of equal area.

Gradual Change of Momentum—If the small duct expands gradually to the large, the rise in pressure cannot be computed by the momentum theorem just developed, because the two ends of the section are not of the same area. In this case the Bernouilli theorem applies; which is, assuming no friction, the pressure head plus the velocity head is constant. Considering Fig. 4—

$$P_2 - P_1 = \frac{w v_1^2}{2 g} - \frac{w v_2^2}{2 g}$$

P_1 and P_2 = Pressures in lb. per sq.ft.
w = Density in lb. per cu.ft.
v_1 and v_2 = Velocities in ft. per sec.
g = Acceleration due to gravity.

The Compressed-Air Jet in the Atmosphere—When a jet of compressed air flows into the open atmosphere it appears to expand into a cone, the

[1] Flugge-de Smidt, R. A. H.: "The Ventilation of Development Ends," *South African Min. & Eng. Journ.*, July 14, 1923. Also, Symposium: "Mine Ventilation," *Journ. Chem., Met., & Min. Society of South Africa*, March, May, June, 1924.

[2] Weeks, W. S.: "Ventilation of Mines," McGraw-Hill Book Company, Inc., 1926, p. 141.

elements of which make an angle of about 7.5 deg. with the direction of flow. This expansion is due partly to the slowing down of the jet and partly to the accession of atmospheric air that is carried along with the jet. The pressure in this cone is that of the surrounding atmosphere.

The core stream—that is, the original jet—strikes particles of atmospheric air and imparts to them some of its momentum. No loss of total momentum occurs. The core stream loses momentum and the new air gains momentum, but the sum remains that of the original jet. This fact was demonstrated by allowing the air stream to impinge at right angles on a large glass plate resting on scales. The nozzle was placed at different distances from the plate and the force of impact measured. The force varied only 2 per cent with the nozzle distance varying from 5 to 20 in. When a stream is turned at right angles in this way, the force is $\frac{W\ v}{g}$, which is the momentum.

The momentum is not evenly distributed in the cone. The velocity is greatest at the center, but fortunately it was found that for all calculations even distribution may be assumed.

Calculation of the Momentum of the Compressed-Air Jet—A specific example of the calculations will be given. The nozzle to be used is shown in Fig. 5. The entrance should be well rounded to prevent contraction.

Velocity at the Throat—At the throat of the nozzle the pressure drops to the critical pressure, which is 53 per cent of the absolute pressure back of the nozzle. Adiabatic expansion takes place and heat energy is converted into kinetic energy. The temperature at the throat is given by the formula

$$\frac{T_1}{T_2} = \left(\frac{P_1}{0.53\ P_1}\right)^{\frac{\gamma - 1}{\gamma}}$$

T_1 = Absolute temperature back of nozzle in deg. F. (Ordinary temperature + 460)
T_2 = Temperature at throat in same units
P_1 = Absolute pressure back of nozzle (Any pressure units)

$$\gamma = \frac{C_P}{C_v} = 1.40$$

Assuming a gage pressure of 80 lb. per sq.in. back of nozzle, atmospheric pressure 14.7 lb. per sq.in., temperature back of nozzle 70 deg. F., the temperature at the throat may be calculated as—

$$\frac{530}{T_2} = \left(\frac{1}{0.53}\right)^{\frac{1.40 - 1}{1.40}}$$

$$T_2 = 442°$$

The velocity of the air in the throat is given by the formula

$$v = \sqrt{2\ g\ J\ C_P\ (T_1 - T_2)}$$

v = Velocity in ft. per. sec.
J = Mechanical equivalent of heat (778 ft.-lb.)
C_P = Specific heat of air at constant pressure (0.240)
g = Acceleration due to gravity (32.15)

Evaluating constants

$$v = 109.9\ \sqrt{T_1 - T_2}$$
$$v = 109.9\ \sqrt{530 - 442}$$
$$= 1{,}025 \text{ ft. per sec.}$$

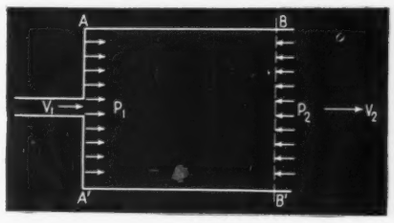


Fig. 3—ABRUPT EXPANSION occurs when a fast stream enters a large duct and slows down with turbulence

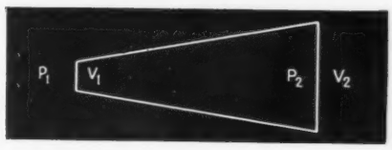


Fig. 4—GRADUAL EXPANSION takes place when a small duct expands gradually to a large one

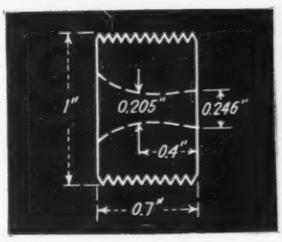


Fig. 5—NOZZLE of a compressed air jet. It is well rounded to prevent contraction

Density at Throat:

$$w = \frac{P\ V}{R\ T}$$

w = Weight in lb.
P = Absolute pressure in lb. per sq.ft.
V = Volume in cu.ft.
R = Gas constant (53.3)
T = Absolute temperature in deg. F.

For $V = 1$

$$w = \frac{0.53 \times 94.7 \times 144 \times 1}{53.3 \times 442} = 0.307 \text{ lb. per cu.ft.}$$

Weight per Minute Passing Throat:

$$W_m = \frac{1025 \times (0.205)^2 \times 3.14 \times 0.307 \times 60}{4 \times 144} = 4.34 \text{ lb.}$$

The flow through this nozzle under the same conditions when measured by displacement tanks was found to be 4.33 lb. per min., so it would seem that the method of calculation is correct.

Final Velocity of Jet—After the air passes the throat the velocity may be increased by using an expanding nozzle. The velocity at the outlet is calculated by assuming that the pressure drops from that back of the nozzle to that of the atmosphere. The final temperature in this case is 312 deg. and the final velocity 1,620 ft. per sec.

The area of the outlet is calculated by determining the cross-sectional area necessary to pass 4.34 lb. of air per min. at a temperature of 312 deg. F. abs., a pressure of 14.7 lb. per sq.in., and a velocity of 1,620 ft. per sec. The throat and outlet sections are connected by a taper with a total angle of 6 deg.

Momentum of Jet—The momentum of the jet, using measured value for flow, is

$$M = \frac{4.33 \times 1620}{32.15 \times 60} = 3.64 \text{ lb.}$$

The Cylindrical Injector—The simplest type of injector is made by allowing a jet of compressed air to blow into the center of a pipe of round section as shown in Fig. 2. This type of injector is inefficient because of large shock losses which are always present with abrupt expansion. The jet draws into the pipe to form the cone only the amount of air that can be forced through the pipe. The cone slows down and a loss of momentum occurs. This produces a rise of pressure in the pipe. The rise in pressure is equal to the change in momentum divided by the area of the pipe. Experiments showed that the following assumptions may be made in the calculations for all injectors:

1. In figuring the momentum in the pipe the density of the atmospheric air may be used.
2. The pressure rise obtained from the calculations will be the rise above atmospheric pressure.
3. The pressure when the duct is shut off entirely may be computed on the assumption that all of the momentum of the jet is lost. A higher rise than this might be expected because the compressed air turns around and comes out again.

Calculation of Pressure in Cylindrical Injector—Assume a 6-in. diameter pipe, the nozzle for which calculations have been made and atmospheric density of 0.075 lb. per cu.ft.

Momentum in 6-in. pipe =

$$\frac{W\ v}{g} = \frac{Q\ w\ v}{60\ g} = \frac{w\ Q^2}{3{,}600\ A\ g}$$
$$= \frac{0.075 \times Q^2}{3{,}600 \times 0.196 \times 32.15}$$
$$= 0.0000033\ Q^2$$

Q = Quantity flowing in pipe in cu.ft. per min.
w = Density in lb. per cu.ft.
v = Average velocity in ft. per sec.
A = Area duct in sq.ft.

Since 1 in. of water = 5.2 lb. per sq.ft.

Static pressure rise in inches of water $= \frac{\text{Change in momentum}}{5.2 \times 0.196}$

Assume 600 cu.ft. per minute to be the flow in pipe:

Momentum of jet = momentum of cone = 3.64 lb.

Momentum in 6 in. pipe $= 0.0000033 \times (600)^2 = 1.19$ lb.

$$\text{Static pressure} = \frac{3.64 - 1.19}{5.2 \times 0.196}$$

$$= 2.41 \text{ in. water.}$$

The calculation of the efficiency for a flow of 600 cu.ft. per min. by the second method would be as follows:

Power in Air at End of Injector:

Total pressure = static pressure + velocity pressure

Velocity pressure in inches of water =

$$\frac{X}{0.075} \times \left(\frac{V}{4000}\right)^2$$

X = Density of air in lb. per cu.ft.
V = Velocity in ft. per min.

$$V = \frac{600}{0.196} = 3061$$

$$V.P. = \frac{0.075}{0.075} \times \left(\frac{3{,}061}{4{,}000}\right)^2$$

$$= 0.58 \text{ in. } H_2O$$

Total pressure $= 2.41 + 0.58 = 2.99$

In this device the compressed air jet draws into the pipe to form the cone only the amount of air that can be forced through the pipe, and the size of the base of the cone that strikes the throat will depend on the quantity circulating. The momentum of the air that strikes the throat will always be equal to the momentum of the jet.

When a small quantity of air is circulating, the base of the cone will be smaller than the throat, so the air slows down when it enters the throat and a loss of momentum occurs which causes a rise of pressure in the throat. At all times when the momentum in the throat is less than the momentum of the jet, the pressure in the throat will be above that of the atmosphere. As the air flows through the expanding part, a rise in pressure takes place according to the Bernouilli theorem. In calculating this rise friction and shock losses may be neglected.

As the gate on the pipe is opened, a point will be reached when the base of the cone is of the same area as the throat, or in other words the momentum of the air in the throat is equal to the momentum of the jet. Under these conditions the injector is operating at maximum efficiency. The pressure in the throat will be close to the atmospheric pressure. All of the rise in pressure takes place in the expanding portion. As the gate is opened, still further and more air is admitted, the base of the cone of air that strikes the throat is larger than the throat, so the air must increase in velocity to enter the throat. This causes the pressure in the throat to drop below that of the atmosphere. Pressure rises again in the expanding portion. During this period when the momentum in the throat is greater than the momentum of the jet the net rise in pressure above that of the atmosphere is merely the difference between the velocity pressure of the air that strikes the throat and the velocity pressure in the duct.

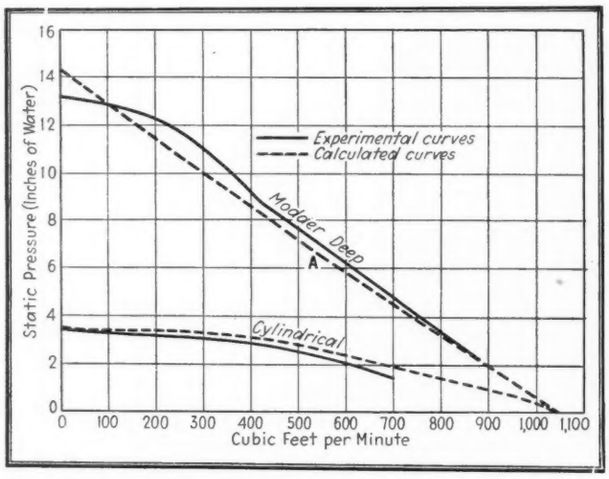


Fig. 6—CHARACTERISTICS, calculated and experimental, of a cylindrical injector, compared with the Modder Deep type

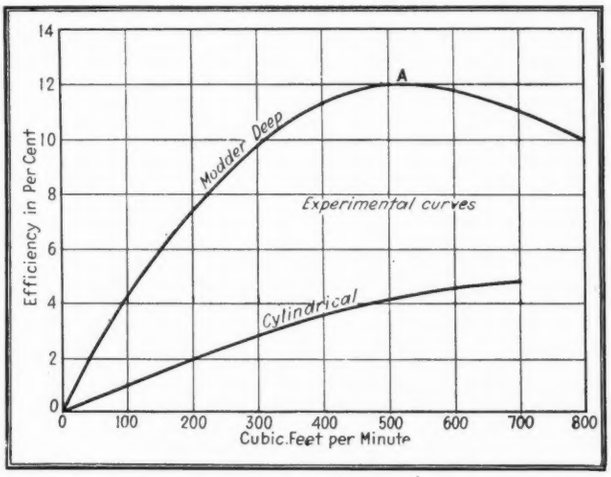


Fig. 7—EFFICIENCY CURVE for cylindrical injector as determined experimentally

In this way, by assuming different quantities other points on the characteristic may be calculated.

For the 0 quantity point

$$\text{Static pressure} = \frac{3.64 - 0}{5.2 \times 0.196}$$

$$= 3.57 \text{ in.}$$

When all resistance is removed the static pressure is 0 and the momentum in the pipe equals the momentum of the jet.

The calculated and experimental characteristics of this blower are shown in Fig. 6. All experimental curves were determined by Lindblom and Johnson.

Efficiency of the Injector—The jet efficiency of the blower may be calculated in several ways: (1) By dividing the total useful energy per unit of time that is expended on the air that is drawn in, by the kinetic energy lost by the jet per unit of time. (2) By dividing the total useful energy that appears at the end of the injector per unit of time by the kinetic energy of the jet per unit of time. Curves calculated by the two methods are nearly parallel, so either method serves for comparative purposes. The second method is more simple.

Energy per minute $= 2.99 \times 5.2 \times 600 = 9{,}300$ ft.-lb.

Kinetic Energy of Jet per Minute:

$$K.E. = W_m \frac{v^2}{2g}$$

W_m = Weight per minute flowing
v = Velocity in ft. per sec.

$$K.E. = \frac{4.33 \times (1{,}620)^2}{64.30}$$

$$= 177{,}000 \text{ ft.-lb. per min.}$$

$$\text{Efficiency} = \frac{9{,}300 \times 100}{177{,}000} = 5.3\%$$

The efficiency of a cylindrical blower starts at 0 and rises as the resistance is removed. It should be used only against low resistances. Fig. 7 shows experimental efficiency curve of injector.

Modder Deep Injector—This injector, seen in Fig. 1, is composed partly of a cylindrical section and partly of an expanding section. Any rise in pressure in the cylindrical section is calculated by the momentum theorem as is done with the cylindrical injector, and the rise in pressure in the expanding portion is calculated by the Bernouilli theorem. The sum of the two pressures gives the total rise in static pressure. The cylindrical part of the injector is termed the throat.

Calculation of the Velocity at Base of Cone:

Momentum of air at base of cone = momentum of compressed air jet.

$$\frac{W\ v}{g} = \frac{Q\ w\ v}{l} = \text{Momentum of jet}$$

Q is assumed, w is known, so v can be determined.

When all resistance is removed, as in the case of the cylindrical blower, the momentum of the air in the pipe at end of injector is equal to the momentum of the jet.

To obtain a sufficiently accurate picture of the characteristic it is necessary to calculate only three points and connect them with straight lines: (1) complete shut-off, (2) momentum in throat = momentum of jet, (3) momentum in pipe = momentum of jet.

These three points will be calculated for the injector shown in Fig. 1 with nozzle for which calculations have been made.

(1) Shut off.

$$\text{Pressure rise in inches water} = \frac{\text{Momentum of jet}}{5.2 \times \text{area of throat}}$$

$$\frac{3.64}{5.2 \times 0.049} = 14.3 \text{ in. } H_2O$$

(2) Momentum in throat = momentum of jet.

The quantity flowing must first be determined. By the same reasoning used for developing the formula for the momentum in the 6-in. pipe, the momentum in the throat is 0.000013 Q^2. Since this is equal to the momentum of jet

$$0.000013\ Q^2 = 3.64$$

Q = 530 cu.ft. per min.

All of the rise in pressure takes place in the expanding portion and is equal to the velocity pressure in the throat minus the velocity pressure at the end of the 6 in. pipe.

Velocity pressure in throat with 530 cu. ft. per min. flowing = 7.256 in. H_2O

Velocity pressure in pipe = 0.456 in. H_2O

Recovery = 7.256 — 0.456 = 6.8 in. H_2O

(3) Momentum in pipe = momentum of jet

$0.0000033\ Q^2 = 3.64$

Q = 1,050 cu.ft. per min. Pressure is zero.

The characteristic obtained from these three points is shown in Fig. 6 as the upper dotted line. The experimental curve is shown as a solid line. Point A is the point of maximum efficiency, as can be seen from the upper curve of Fig. 7. At point A the momentum of the jet is equal to the momentum in the throat.

To determine the flow when the injector is placed on a given duct, plot the duct characteristic on the same chart as the injector characteristic. The crossing indicates the rate of flow. The duct characteristic is a curve that shows the pressure necessary to force given amounts of air through the duct.

Design of an Injector—Given the pressure and rate of flow, an injector should be designed to operate at the point of maximum efficiency. This means that the momentum in the throat should be equal to the momentum of the jet. The entire pressure rise is to come from the conversion of velocity pressure into static pressure in the expanding portion of the injector.

Compute velocity pressure in duct with desired flow. This value plus the desired pressure is the velocity pressure in the throat. From this the velocity in the throat can be calculated. Knowing the volume flowing per unit time and velocity, the area of the throat can be found.

Knowing weight flowing per unit time, and velocity at throat, the momentum in throat can be calculated.

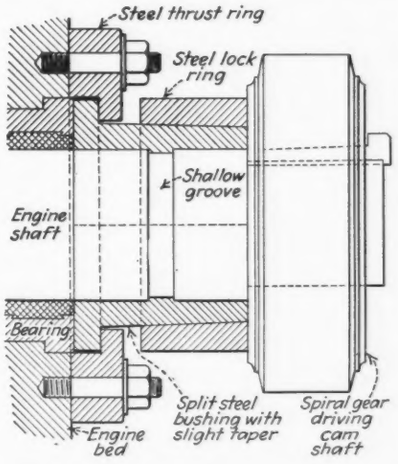
If compressed-air pressure is known the velocity of jet can be calculated. Since momentum in throat = momentum of jet, the weight of compressed air per second can be found. The dimensions of the nozzle can now be determined by applying the principles stated in the discussion of the compressed-air nozzle.

Practical Consideration—The nozzle should always be so placed that the jet blows along the center axis of the injector. In the cylindrical injector the nozzle is placed at the entrance of the pipe. In the Modder Deep type, consider the throat the base of a cone with an apex angle of about 18 deg. and place the nozzle at the apex. It is well to allow for a little adjustment so that the best position can be found.

▼ ▼ ▼

Oil-Engine Repair

RECENTLY, a 75-hp. oil engine was installed at a remotely situated gold mine on the west coast of Mexico, to provide electric current for a pump handling drinking water



and lights for the camp. After only a few hours' run the spiral gears actuating the camshaft started to operate noisily and wear on the gear teeth necessitated an immediate shutdown of the engine. A careful investigation on the part of the master mechanic disclosed that because of absence of a truss or band on the crankshaft near the main bearing flange the crankshaft moved sideways, thereby moving out of alignment the two gears.

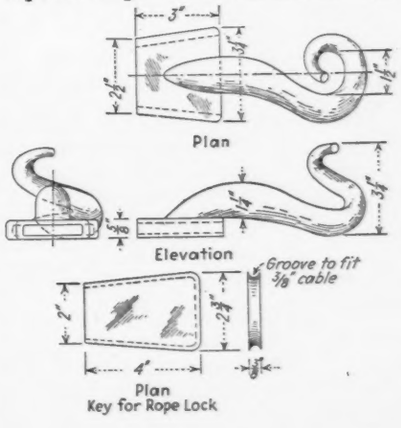
To overcome this difficulty, it was first thought to make or order a new gear with a grooved, flange-like extension, the crankshaft to be held in place by a steel thrust ring bolted to the side of the engine bed. The idea had to be discarded, however, because (1) no milling machine was available at the shop, and (2) more than six weeks' time would be required to get such a gear from the factory. The problem was finally solved in the manner shown in the accompanying sketch.

After providing the crankshaft with a shallow groove, a split steel bushing with a slight taper, a steel lock ring, and a thrust ring to be bolted on the side of the engine bed were made from scrap material and installed on the crankshaft as illustrated.

▼

Useful Pigtail Hook

The pigtail hook herewith was made in the blacksmith shop at the Virginia mine of the Oliver Iron Mining Company, for use at the Spruce and Leonidas underground mines to secure a close couple on a ⅜-in. cable when using the underground slushers and hoists. The pigtail hook makes a safe connection, preventing uncoupling, and is strong enough to break a ⅜-in. cable. It is easy to disconnect from the cable and permits the cable to be threaded through any combination of blocks before the pigtail is attached. By changing the key for the rope lock a ½-in. cable can also be used.



Canadian Institute Meeting Reflects Active Industry

Record-Breaking Attendance Marks C.I.M.M. Convention

CONVENING in Montreal on March 15-17, for its 38th annual general meeting, the Canadian Institute of Mining and Metallurgy held one of the most successful conventions in its history. Registration was about 800, which is about one-third of the membership. The large attendance reflected the active and prosperous condition of the Canadian mining industry, which has been an economic mainstay to the Dominion throughout the depression and is still leading the way to prosperity. As pointed out in one of the opening papers, mineral production for 1936 was valued at $361,000,000 and included rare, precious, and base metals, fuels, and industrial minerals. At the invitation of the Toronto branch of the Institute, the annual general meeting for 1938 will be held in Toronto.

Questions Discussed Freely

Indicative of the steady growth in membership of the Institute, with its accompanying problems and policies, was the presidential address of G. E. Cole, "The Institute—Whither Bound?" President Cole posed a number of questions relating to the objects and scope of the Institute. Is it a professional society, or does it encompass mining as an industry? Should the membership be classified, with the establishment of a professional division of qualified engineers? Is the Institute's function in the mining industry primarily the dissemination of technical knowledge, or should it give attention also to the economic and social aspects of the mineral industry? These questions were discussed freely at an open forum on Institute policy in the concluding session. There was a mild sentiment in favor of classification of the membership, but the consensus of opinion seemed to favor conducting the Institute along current lines, enforcing more strictly the existing qualifications for membership, and continuing to represent the mining industry as well as the profession.

Among the technical papers, exceptional interest centered in "Ball Mills—High vs. Low Discharge," by the Hollinger mill staff, presenting the results of mill tests extending over a period of fourteen months. The paper is published in the February *Bulletin* of the Institute. Among the main conclusions drawn from the tests are: (1) A low-discharge mill will grind more tons of ore to a given fineness than will a high-discharge mill of the same size, with a slightly lower power consumption per ton and at a lower over-all cost per ton. (2) A mill 6 ft. 6 in. diameter by 14 ft. 6 in. long will grind 93.3 per cent of the tonnage that two mills of the same diameter but half the length will grind. (3) Maximum economy and capacity were obtained at, approximately, a speed 80 per cent of critical and a ball load 50 per cent of the mill volume.

"Splitting the Minus 200 With the Superpanner and Infrasizer" is a title sufficient in itself to attract attention, but the story of the achievement gains interest when told by Prof. H. E. T. Haultain, who developed the two devices after long years of experimentation. In Canada the superpanner and the infrasizer have taken their place as instruments of precision for the millman in studying his ore and the results of the process to which it is subjected. The superpanner reveals information otherwise unobtainable in the examination of a ground ore or mill product, and the infrasizer yields unbelievably consistent results in splitting minus 200-mesh pulp into fractions. But good and useful as these devices are, they are not to be committed to the unskilled care of the average millman.

Other technical papers dealt with geophysical prospecting, by Hans Lundberg; microscopy in gold milling, by M. W. Haycock; mining and milling at Siscoe, by C. O. Stee and staff; mining at Noranda, by Oliver Hall; geology at the Argosy gold mine, by H. C. Horwood; and the Cadillac-Malartic area, by H. C. Gunning and J. W. Ambrose.

Industrial Minerals

The industrial minerals section, which is growing in importance, held two sessions dealing with the industrial mineral resources of the Dominion and their exploitation. Many of these minerals are basic to substantial manufacturing industries, and have begun to assume economic importance. In 1936, for example, the value of industrial mineral production was $17,000,000, out of a total mineral production of $361,000,000. Much of the technology developed in the treatment of metallic ores is now being applied to industrial minerals, with consequent improvement in the grade and quality of the products and efficiency of the processes. Two technical papers presented to the section dealt with froth flotation and agglomerate tabling, by O. C. Ralston; and high intensity magnetic separation, by D. M. Ramsey and B. K. Brier.

The customary social functions enlivened the proceedings. The smoker program was well done, with exhibitions of boxing and wrestling, and a floor show. The annual dinner and dance concluded the meeting, at which addresses were given by the Dominion Minister of Mines and Resources and the Prime Minister of Quebec.

Numerous Awards Made

Of more than usual interest was the dignified and impressive presentation of medals and awards at the Institute luncheon. The medal for bravery—the "Victoria Cross" of the Canadian mining industry—was awarded to John Leja, James Clark, and Charles P. O'Dale, of the Lake Shore Mines, who risked their lives to rescue a fellow miner who had been injured by a premature blast. Cash awards to students for papers on mining subjects were presented to A. P. Farley, University of British Columbia; A. E. Gallie, University of Toronto; W. J. Marshall, Queens University; and honorable mention to J. D. Hall, McGill University.

Accident prevention awards were won by J. M. Wolverton, safety engineer of the Sullivan mine, Kimberley, B. C., and W. B. Paton, inspector of mines for Manitoba. The Barlow memorial prize in economic and applied geology went to W. T. Robson, chief geologist, Lake Shore Mines. The McKee trophy for outstanding contribution to the advancement of aeronautics was awarded to "Matt" Berry, pilot for Canadian Airways. The Leonard medal was given to L. S. Weldon, formerly of the Lake Shore Mines but now in Kenya Colony.

Two of the most highly prized honors were bestowed on Prof. H. E. T. Haultain, University of Toronto, and A. L. Blomfield, managing director of Lake Shore Mines. The former received the Randolph Bruce gold medal in recognition of his contributions to ore grinding and sizing; and the latter was awarded the platinum medal of the International Nickel Company, for distinguished service to mining and metallurgy.

California

Compensation Insurance Rates Lowered

Safety practices bring reward to mine operators in State—Silverado mine reports high-grade strike

▶ California mine operators are elated over the reduction in rates for workmen's compensation insurance as announced by the California Inspection Rating Bureau. The new rates constitute a decrease of about 15 per cent, and become effective April 1, 1937. They are as follows: Underground mining $9.44, with a surcharge for silicosis of $2.24; surface mining $7.72, and a silicosis surcharge of $0.56; ore milling $2.41, with a surcharge for silicosis of $1.40; and for surface employees not engaged in mining a flat rate of $7.72 (no surcharge) is imposed. Previous rates were $10.97 for underground workers, $9.15 for all surface workers, and $2.84 for mill men on each $100 of payroll, exclusive of the silicosis surcharges instituted last year, which, as previously mentioned, amount to $2.24, $0.56, and $1.40 respectively. The rate for mine commissary employees, however, was increased to $1.77 from $1.43. Installation of safety devices and the general safety consciousness of mine operators may lead to further rate reductions in 1938, when the rates are again to be revised.

▶ Golden Center Mines, Inc., operating the Golden Center property, in the heart of Grass Valley, has recently completed the underground connection between the Golden Center and the adjoining Scotia mine, and all operations are now conducted through the Scotia shaft. Development work is in progress in the Scotia mine and neighboring claims, and several shoots of commercial ore are said to have been discovered recently. Both properties are controlled by the Cooley Butler interests of Los Angeles.

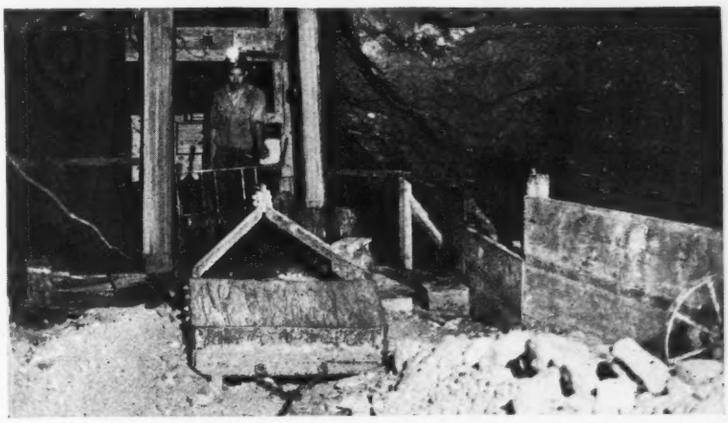
▶ An assessment of 5c. a share on all outstanding stock, both preferred and common, is being levied by the Central Eureka Mining Company, at Sutter Creek, to obtain funds for further development of the 3,000-ft. level, where an orebody containing good values was opened up recently. James Spiers, superintendent, is in charge of operations.

▶ Milling operations have been resumed at the Mount Gaines mines, near Hornitos, with 20 stamps crushing from 80 to 100 tons of ore a day. The pulp is treated by amalgamation and flotation. At the mine the 1,300-ft. shaft has been reconditioned and adequate pumping facilities have been installed. Apart from the work carried on underground on four levels, the company plans to explore additional sections of the mine believed to contain ore of good milling grade. The property is operated by the Mount Gaines Mining Company, A. G. Ilseng, president, which company is also rehabilitating the King Solomon mine, at Randsburg. Work at Mount Gaines is under the direction of N. L. Wagner, consulting engineer.

▶ The mill of Carson Hill Gold Mining Company, at Melones, is reported to be treating 1,000 tons of ore a day since completion of improvements made at the mill and at the cyanide plant. In the mine, the winze on the 3,000 level, which affords access to the lower workings, has been unwatered to the 3,500 level, and extensive development at that depth is contemplated. On the 3,160 level, the orebody encountered recently and the two oreshoots opened up by additional crosscutting in the footwall on the same level are being developed. The former is said to average $7 per ton. Charles A. Segerstrom is president of the company, and John A. Burgess, general superintendent, directs operations at Melones.

▶ Six men were killed and five others slightly injured when, early in March, a powder train exploded on the 700-ft. level of the Walker mine, in Plumas County, operated by Walker Mining Company. The exact cause of the explosion has not been determined yet.

▶ A vein 6 ft. wide and assaying about 100 oz. of silver per ton is reported to have been uncovered 550 ft. above the main working level at the Silverado mine, in Mono County, according to T. S. Davey, manager, Sierra Consolidated Mines Company, owners of the property. The discovery is believed to be the upward extension of the orebody originally found on the 900-ft. level, and drifting is in progress to determine the extent of the strike.



Underground operations by the Carson Hill Gold Mining Company in California are expected to increase following development on the 3,500 level, recently unwatered. Scraper and double-drum slusher hoist are shown working on one of the upper levels.

▶ United Gold Properties Corporation, operating the Dicky Boy mine, in the Sonora area, plans to increase the capacity of the mill placed in operation recently from 30 tons to 75 tons by installing a 5x4-ft. Hendy ball mill and additional flotation equipment. A 10-ton cyanide unit may be added to the surface plant later. The mine is opened by a shaft, and mining operations are in progress on the 200-ft. level. L. R. Cordray, president and general manager, directs operations.

▶ The Cal-Mur Company, developing the Cal-Mur quicksilver mine, near Los Alamos, is installing a 30-ton Gould rotary furnace plant. The company is controlled by Santa Barbara interests, with O. Pfutzner in charge of operations.

▶ Installation of new equipment to increase the capacity of the mill at the Walker Consolidated mine, in the Old Diggings district, near Redding, to 200 tons is planned by the Dowling Mines Company, J. J. Dowling, president. About 75 tons of ore, said to average $10 per ton, are now treated daily.

▶ For a consideration said to exceed $100,000, Piute Mining Company, William J. Quackenbush, manager, Wilmington, Calif., has purchased the Skyline mine, in Pine Tree Canyon, 15 miles northwest of Mojave. Included in the sale are a 35-ton flotation-concentration mill, hoisting and compressor machinery, and other equipment. Development of the mine will start at once under the direction of Verne Moore. The company also operates the Piute mine, formerly known as the Burning Moscow, about 46 miles northwest of Mojave.

▶ Lode Development Company, Marshall D. Draper, manager, is reported to have concluded arrangements for early construction of a 100-ton flotation plant at the Rosencranz mine, in Garden Valley, acquired recently by the company.

Correction. On page 153 of the March issue of *E. & M. J.* the statement was made in a caption that the tailings plant of the Kennedy Mining & Milling Company was at Jackson and that it was closed for repairs. The tailings plant (capacity 1,500 tons) is at Martell, near Jackson, and it was the company's stamp mill at Jackson that was temporarily closed for repairs.

Surface buildings of the Tennessee-Schuylkill Corporation at Chloride, Ariz. The mill is treating about 175 tons of lead-zinc ore daily, and lead concentrates are shipped to El Paso and zinc concentrates go to the smelter at Amarillo, Tex.

Arizona

Air-Conditioning for Magma's Lower Levels

Cooling plant expected to be in operation by summer—Shattuck Denn Mining Corporation developing its new orebody

▶ Magma Copper Company, near Superior, is preparing to install a cooling plant on the 3,600 level. The plant is expected to be ready in July and is designed by Carrier Corporation, of Newark, N. J. Two centrifugal refrigerating units for cooling water will be on the 3,600 level, together with two pumps for circulating cooling water, a cooling coil, and a booster fan. On the 3,400 level will be installed a cooling coil and a booster fan. A new 250-ton mill section is being added to treat ore from a zinc orebody developed years ago. Equipment to be installed includes ball mills, classifiers, flotation machines, and tanks. William Koerner is general manager, J. H. Rose is mill and smelter superintendent, and J. C. McNabb, assistant mill superintendent.

▶ On April 1 Arizona copper miners received their fourth wage increase in the last six months. The new scale is now $5 per day for surface labor, $5.40 minimum for underground labor, $5.70 for machine men, and $6 for timbermen. P. G. Beckett, vice-president of Phelps Dodge Corporation, expressed concern over the high price of copper abroad forcing the domestic quotation to 17c. He said: "The question may be asked, how much of it is because of unpredictable armament demands and speculation, which may bring collapse at any time?"

▶ Phelps Dodge Corporation's smelter at Douglas is now treating about 3,000 tons of ore and concentrates per day. A roasting plant, three reverberatory furnaces, four converters, and an acid plant are in operation. Another reverb is being constructed and equipped with a new waste-heat boiler. The management has started foundations for a new power house, which will have sections to permit individual operation of the reverbs, thereby eliminating the costly method of operating large units at half or less load.

▶ Shattuck Denn Mining Corporation, in the Warren district, is steadily developing the recent ore discovery made on the 2,430 level. The orebody is said to average 600 ft. long and 110 ft. wide, assaying about 10 per cent copper with some silver and gold. Ore from development is shipped to the smelter, and in about five months exploitation of the orebody is expected to start, raising production from 10,000 to 15,000 tons monthly. The Denn shaft is completed and concreted to 2,700 ft. and development is progressing rapidly between the 2,300 and 2,500 levels. John Flynn is general manager. Production from the Denn mine in 1936 was 3,303,690 lb. copper, 1,899 oz. gold, and 47,206 oz. silver.

▶ The Tombstone Development Company, at Tombstone, is mining ore from two stopes above the 400 level and drifting on the 300, 400, and 500 ft. levels. Between 500 and 600 tons of ore are mined by the company monthly, and leasers on the property ship about 700 tons. E. Holderness is manager.

▶ At the Bunker Hill lease of the United States Smelting, Refining & Mining Company, in Tombstone, development is being done on the 400 and 500 levels. E. P. Jeanes is in charge.

▶ The Eagle-Picher Mining & Smelting Company, at Ruby, the largest lead and zinc producer in Arizona, is milling about 400 tons of ore daily. Lead concentrates are shipped to El Paso and zinc concentrates to Amarillo, Tex. E. V. Morton is manager, G. J. Duff, general superintendent, E. H. Crab, mill superintendent, and T. J. Johnson, mine superintendent.

▶ Veta Mines, Inc., of Denver, recently placed in operation the company's 100-ton flotation mill, treating a silver-gold ore hoisted through the Shamrock shaft, at Hardy. Robert Sayre, of Denver, is president of the company and H. P. Nagel, Jr., is superintendent at the mine.

▶ L. E. Foster and associates, of Phoenix, are rehabilitating the Kay mine, near Canon, in Yavapi County, for production. Ownership was acquired through tax titles. The mine was formerly operated by the Kay Copper Company, but it has been idle since 1929.

▶ The American Smelting & Refining Company is reopening the Clara-Swansea mines, near Bouse. About 50 men are now employed. Prior to the shutdown in 1930 the company built a 250-ton flotation plant and operated for a few months, until the price of copper declined. Ernest E. Lane, of Bouse, is mine superintendent and B. R. Thatcher, of Tucson, manager.

▶ The old Yuma mine, about 14 miles west of Tucson, in the Amole district, has been optioned by W. E. Holt, of Tombstone. The mine has been a producer of molybdenum, lead, and silver and has been operated at various times in the past. It is developed to a depth of about 300 ft. on the incline, although much early mining was done by the glory-hole system. A 250-ton mill was built in 1916.

▶ Stephens Mines, Inc., is installing a 25-ton mill and cyanide plant on its property in the Quijotoa district, in Pima County, near Sells. W. E. Hadsell, of Buckeye, is in charge of the mill and Arthur P. Stephens, who heads the company, is general superintendent.

▶ The Keystone Mining Company, at Casa Grande, reports the discovery of an 18-in. vein of $45 gold ore at a depth of 40 ft. in the new shaft at the Queen mine. The Queen adjoins the old Greenback mine, one of Arizona's oldest gold-producing properties, and the present find is believed to be an extension of the vein from the Greenback mine. Charles W. Humphries is president of the company and directing the operations.

▶ Hazell Metals Corporation, operating the old McNeil-Belmont property, near Buckeye, is installing new machinery and will soon be in production. The property has been recently examined by Roy G. Mead, a Los Angeles engineer, who reported sufficient ore for operations. The mine was taken over during 1936 by the Hazell corporation, of which George W. Wilkins is manager. Offices of the company are at Glendale, Calif.

▶ Christmas Copper Company, 2 miles west of Christmas station, in Gila County, has retimbered the main shaft to 625 ft., and preparations are being made to resume operations. Harvey A. Rossell is general manager.

Nevada

Weepah Nevada Mining Starts New Cyanide Mill

This plant has replaced flotation units—Bralorne Mines Company, of Canada, reported to have bought the Nivloc property

▶ A new 300-ton cyanide mill is in operation at the gold property of the Weepah Nevada Mining Company at Weepah, Esmeralda County, replacing the 250-ton flotation mill in use until the new plant was completed. Ore is delivered by motor trucks from the open-cut mine, the major part of which is leased from the Weepah Horton Mining Company. J. C. Perkins, of Tonopah, is manager.

▶ Sale of the Nivloc silver-gold mine, in western Esmeralda County, to the Bralorne Mines Company, of Canada, is reported. The Nivloc, west of Silver Peak, was opened some years ago by W. H. Colvin, of Chicago, whose reversed name was given the property. Subsequently it was acquired by Fred Vollmar, Jr., head of the Black Mammoth Consolidated Mines Company, operating the Mary and other mines at Silver Peak, now under option to E. L. Cord, automobile manufacturer. Application for an RFC loan of $20,000 made by Nivloc was approved, and development is said to have blocked a large tonnage of high-grade mill ore. A large-capacity cyanide mill is planned.

▶ Directors of the Goldfield Consolidated Mines Company, elected at a recent annual meeting held at Evanston, Wyo., include George Wingfield, E. A. Julian, J. J. McCormack, T. L. Willcox, George B. Thatcher, William Woodburn, and M. Rice. On March 1 the company is said to have received the balance of a $150,000 first payment for its Goldfield properties from the Eastern Exploration Company, which had paid over $130,000 in royalties on ore shipped to smelters.

▶ Employing more than 400 men, the Consolidated Coppermines Corporation, at Kimberly, is increasing production of copper ore and by mid-April will be trucking 3,000 tons per day to the McGill plant of the Nevada Consolidated Copper Company, according to J. B. Haffner, manager for Coppermines. Mr. Haffner said that if the offer of American Metals to make a further exchange of stock was accepted, Coppermines probably would build its own smelter at the mines.

▶ An RFC Class B loan of $20,000 has been authorized to the General Tungsten Corporation for development of a scheelite property 6 miles southwest of Mina, in Mineral County, not far from the Silver Dyke mine of the Nevada-Massachusetts Company.

▶ Shipments of high-grade gold ore in good volume continue from properties of the Goldfield Consolidated Mines Company, now operated under lease and option of purchase by the Eastern Exploration Company, a subsidiary of Calumet & Hecla Consolidated Copper. Eastern Exploration is driving on the 500-ft. level of the Clermont to explore the Velvet claims of the Jumbo Extension, upon which it has a working lease, and is developing the Simmerone claims, which it purchased recently.

▶ Organization of the Premier Gold Mines, Inc., has been completed at Tonopah, the new corporation acquiring assets of the White Caps Gold Mining Company, the Manhattan Consolidated, Nevada Coalition Company, and a number of adjacent claims, all in the Manhattan district, Nye County. Directors include John Connolly and C. F. Wittenberg, of Tonopah, and Thomas F. Cole, of Pasadena, Calif. Homer L. Williams, of Tonopah, is manager and resident agent.

Utah

Molybdenum Produced At Utah Copper

Small quantities in low-grade copper ore now being recovered by flotation—Preliminary work on 22,000-ft. tunnel started

▶ The year 1936 was notable for Utah Copper, not only in increased production of the red metal, but for the production of a small tonnage of molybdenite concentrates as a byproduct of its copper operations. The value of the 60 per cent molybdenite concentrate recovered is only a few cents to the ton of crude copper ore, according to D. D. Moffat, general manager of the company. Although recoveries are not yet completely satisfactory, the steady improvement promises increasing production, which may make Utah Copper's output a sizable factor in the tonnage turned out annually in the United States.

▶ Another sign of prosperity is the announcement of J. O. Elton, general manager of the International Smelting Company, that drilling the 22,000-ft. tunnel from Tooele to Bingham, a project long discussed, will be started this spring. The first digging started late in March. Merger of the Utah-Apex and the Utah-Delaware Mining companies, in Bingham, and the formation of the National Tunnel & Mines Company, make this project possible. J. A. Norden, former general manager of the Utah-Apex Mines Company, will be manager of mines for the new tunnel company. The cost of the tunnel will be about $650,000. The bore will be large enough to allow the laying of standard-gage railroad track and the operation of specially designed cars. Development of the Utah-Apex and Utah-Delaware lower levels will be the objective.

▶ Another transaction of major importance to the Bingham district is purchase of the Ohio Copper property by the Utah Copper Company for $600,000. Ohio Copper, however, retains possession to the property below its main haulage level. For some years, the mine has been operated by leaching in place. This May, it was to be sold by Salt Lake County for delinquent taxes. D. D. Moffat, general manager of Utah Copper, reports that his company wants the upper part of the Ohio Copper as a right-of-way for railroad lines and the vehicular tunnel to be driven, beginning April 1, between Bingham and Copperfield, in upper Bingham Canyon. According to Percy H. Kittle, manager of the Ohio Copper Company, the sale will allow the company to re-treat its 5,000,000 tons tailing dump and also to develop the limestone beds in the lower horizons of the mine.

▶ Utah members of the International Union of Mine, Mill and Smelter workers recently accepted a sliding scale plan of wages based on the current prices of copper and lead. The plan is similar to that adopted in Butte. A base price of 77.57c. an ounce for silver has been adopted; lead must remain at or above 40 per cent of the price of copper. Base rates for machine miners are established with the present differentials between the different types of labor preserved. As at Butte, the day wage will be advanced 25c. each time the market price of copper increases 1½c. and maintains the increase for 30 days. Reductions follow the same rule. Eureka and Tooele miners have endorsed the sliding scale. Park City and Bingham members, after rejecting the plan informally, ratified the proposed plan on March 30, together with miners from the Lark and Bauer locals.

▶ Combined income of the Tintic Standard's wholly owned properties and the Eureka Standard for 1936 amounted to $697,955.44, compared with $472,480.53 in 1935. Opening of a copper-gold-silver orebody in the Eureka Lilly property on the 1,450-ft. level has greatly improved the outlook of the Tintic Standard subsidiary, being mined from a crosscut from the Tintic Standard No. 2 shaft.

▶ Operations are being pushed in the Park City Consolidated property for the purpose of developing the East Crescent fissure on the 1,050 and 1,200 levels. From these two levels, Gloyd M. Wiles, manager, expects to produce in excess of 150,000 tons of ore. Sinking of the three-compartment winze from the 1,050 to the 1,200 level is under way. During 1936 the company received $389,855.11 in net smelter returns; and operating profit amounted to $25,197.35 before depletion, depreciation, and income taxes.

▶ P. J. Fennell has leased for three years the United Sunbeam Mining Company property in the South Tintic district at Eureka. A crew of ten men is repairing the 400-ft. shaft. A new headframe, a hoist, and a compressor have been installed. Sinking the shaft to the 600 level is proposed so as to develop a body of sulphide ore that was found before the mine was shut down.

▶ The Silver King Coalition Mines Company, at Park City, has started operating its new electric hoist at the main shaft, replacing the old steam hoist, which had been in continuous operation since 1893. The new electric hoist is driven by a 400-hp. motor.

Idaho

Capacity Increase For Zinc Plant

Heavy demand for electrolytic zinc warrants expansion—Miners in Coeur d'Alene get wage increase

▶ The directors of Sullivan Mining Company plan to increase the capacity of the electrolytic zinc plant at Kellogg, according to Stanly A. Easton, president of the company. The Hecla and the Bunker Hill & Sullivan are joint owners of the Sullivan Mining Company, operating the Star mine and zinc smelter. In 1936 the plant produced 21,223 tons of zinc and 180 tons of cadmium. It has not yet been determined if the capacity increase will be 50 or 100 per cent.

▶ The Morning and Page mines of the Federal Mining & Smelting Company made a marked advance in earnings in 1936 over the record for the previous year, according to the annual report of H. G. Washburn, general manager. During 1936 the Morning mine sent 313,866 tons of ore to the mill, an increase of 15,699 tons over 1935 tonnage. Average grade of ore mined was 8.2 per cent lead, 3.1 oz. silver, and 6.5 per cent zinc. Earnings were $759,799.35, an increase of $344,130.18 over those for 1935. The mine operated on a five-day-week basis during the year. Ore reserves at the Page mine are estimated at 350,000 tons. An oreshoot 530 ft. long was opened recently on the 1,200-ft. shaft level.

▶ The Hypotheek mine, in French Gulch, 10 miles west of Kellogg, will again become active under the stimulus of higher metal markets, according to Otto A. Olson, secretary-manager, of Wallace. During its active days the property produced and shipped 185 cars of lead-silver ore and had a modern 200-ton concentrator in operation. The new program calls for an unwatering of the main working shaft to the 900 level and continuation of a crosscut to the south vein, which will be reached in 1,000 ft. of work.

▶ The new 500-ton mill for the Polaris company will be completed by May 1, according to James F. McCarthy, of Wallace, president of the company.

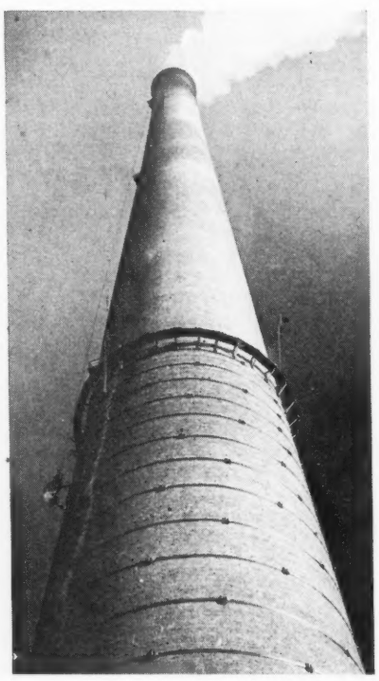
▶ The mill at the Silver Crescent property, formerly the Charles Dickens, in Moon Gulch, 4 miles east of Kellogg, will soon begin operations, according to Stewart Campbell, former State Mine Inspector and now consulting engineer at the Crescent.

▶ Articles of incorporation for the Aurora Mining Company have been filed in Wallace by H. H. Underhill and N. S. Underhill, of Spokane, and C. M. Schak, of Wallace. Offices of the company will be in Wallace.

▶ The Silver Dollar Mining Company, one of the W. J. Stratton projects, located in the silver belt of the Coeur d'Alenes, is ready for a comprehensive development program following announcement recently that the company's shares had been accepted by the SEC. The company will sink a shaft on the Polaris vein and explore the eastern extension of the Sunshine vein. William J. Stratton, of Spokane, is president of the company.

▶ The higher prices for lead and zinc have developed plans for reopening the Douglas mine, on Pine Creek, west of Kellogg. A new board of directors, headed by Stanly A. Easton, president-manager of the Bunker Hill & Sullivan, and James McCarthy, president of the Hecla, has taken over management of the property. Other directors were George Edmiston, Leo Hoban, James E. Gyde, Herman J. Rossi, and Henry Adami, all of Wallace.

▶ Wages of miners in the Coeur d'Alene district were advanced 50c per day on March 16, setting the wage scale at the highest mark ever paid in the district and ahead of any other mining camp in the nation. Announcement of the increase was made by the Federal Mining Company, Bunker Hill & Sullivan, Hecla Mining Company, Sunshine Mining, and Sullivan Mining Company. Under the new scale timbermen will receive $6.75 per eight-hour shift; miners, $6.25; shovelers, $5.75, common labor, $5.50. At the Sunshine mine the wages are 50c. higher. This affects approximately 4,000 employees.



Banding the second tallest smokestack in the United States at the Tacoma smelter, in Washington. The circular staging was lifted as bands were placed at 12-ft. intervals, adding support to the structure. The stack is 572 ft. high.

▶ The Dayrock Mining Company acquired practically all of the outstanding stock of the Coeur d'Alene Mining & Smelting Company, Ltd., early in March. The last named company owned a group of ten claims, adjoining the Dayrock on the north, said to contain extensions of the Dayrock vein system. The basis of the transaction was an exchange of Coeur d'Alene Mining stock for Dayrock on a ratio of practically fifteen shares of the former for one share of Dayrock. F. M. Rothtock, of Spokane, is president of the Dayrock company and Henry L. Day, of Wallace, manager.

Montana

Humphrey Gold Corp. To Mine Near Clancy

Placer ground is tested and operations will be started this year—Vermiculite production near Libby increased

▶ The Humphrey Gold Corporation, operating on Alder Gulch, near Virginia City, is planning to establish a similar operation this spring near Clancy, Jefferson County. A dry land washing plant previously operated by the company near Breckenridge, Colo., will be dismantled and moved to Clancy, where a large acreage of placer ground has been proved during the past two years. The Clancy plant will differ in many respects from that now in service at Virginia City, but the most important one is that the Clancy set-up will employ individual washing and screening units rather than a combined unit, as at Virginia City. D. G. Brown will be in charge of this operation as well as the one at Virginia City. The Adler Gulch plant was forced to close down for about two months during the most severe winter period, but resumed operations about March 1.

▶ At a meeting of the directors of the Butte Highlands Mining Company held at its offices in Spokane on March 17, a plan of reorganization was approved. According to the plan, W. S. Norman and W. L. Bell, both of Spokane, assume the operating control of the company for a period of two years, in consideration for their cash advances and services rendered in effecting the reorganization and their personal supervision of the operation for the specified period.

▶ News has been received from Libby, the center of activity of the Zonolite Company, that a large amount of new machinery has been ordered, with the objective of stepping up substantially the production of zonolite. Zonolite is a trade name for vermiculite, a mineral of the mica group, which exists in very large commercial quantities at the company's property. The product is used as an insulation material, for both sound and heat protection. The concern is under the control of strong Detroit interests, including the Fisher Brothers.

NEWS FROM Washington

By Special Correspondent

UNIONIZATION in mass-production industries is proceeding much more rapidly than Washington thought possible. The early agreement on cooperation in the steel industry proved to Washington the tremendous power of the present movement led by Lewis, if any proof were needed. And it has rather deflated the bombastic arguments of those who talk about "ruthless" industrial managements.

Forecasting regarding the schedules of unionization and the technique to be used is futile. Every interested party in Washington has its own theories. But there is unanimous agreement as to one factor: Costs of goods generally will be advanced. No one, not even the most ardent academic reformer, believes that industry can absorb rapidly advancing wages without corresponding, if not proportionate, price adjustments.

Inflation?

THESE advancing prices of industrial commodities are not in themselves inflation. But the inflationary influence which they impose on the industrial situation has occasioned much argument, which undoubtedly is but a symptom of real Administration concern with present trends. One could have no better proof of the seriousness with which the situation is viewed in the Capital than the frank statement made by Chairman Eccles of the Federal Reserve Board on March 15. That carefully prepared document clearly indicates the trend of official thinking. It may even be safely used as the best available index of the President's plans for further fiscal management as of the date when the statement was made.

An "easy money policy" continues an important objective of the Federal Reserve Board, despite its sincere effort to curb speculative use of excess bank reserves, especially in the stock market. No realist doubts that the Government must continue this policy, at least until budget balancing eliminates the need for further borrowing. No one expects that goal to be reached, although Administration leaders still repeat the "hope" for the fiscal year 1938. Social Security funds flowing in from old-age pension levies will be necessary in larger total than now anticipated to accomplish the apparent balancing which is forecast for that early date.

The really alarming feature to nonpartisan Washington economists is the observation of recent *industrial* goods price movements. In the three years which ended with the summer of 1936 there had been a very small upward movement of these materials prices, not more than 2 or 3 points in the index numbers based on the stable period of the pre-depression period. But in the last seven or eight months there has been an advance of from about 78 to 88 in these goods prices. This rise is, in fact, about the same as that which occurred between the bottom of the depression in 1932-33 and the stable period from 1933 to 1936.

Economists point out that we have now a new upsurge which probably represents a beginning of a sharp upward spiraling of prices and wages. Uncontrolled, this will inflate industrial conditions to the point of a new collapse. The variation of opinion is largely as to speed of effects and time before reversal in trend must come.

Government Ownership

RENEWAL of talk about Government intrusion into business, as proprietor or operator, is notable about Washington. Three important factors probably underlie this recurrence of management fear:

1. It is well known that outstanding labor leaders believe that they can gain advances for unions more rapidly when the Government has in some measure a proprietary or managerial relationship. The progress of C.I.O., and decadence of A.F. of L., make this factor more potent than usual.

2. The newly named Maritime Commission includes outstanding leaders in the theory of public ownership of American shipping.

3. The Eccles statement on credit and monetary policy, already referred to, included a little noticed but highly significant paragraph on policy. It was: "The remedy lies not in a restrictive monetary policy, but in vigorous government intervention with all the powers at its command to deal directly with the causes that might endanger the progress of a stable and enduring recovery."

The President undoubtedly intends to have his way with respect to many matters. His recent public comments on economic and social conditions can rightly be interpreted as meaning an unabated effort in behalf of the "downtrodden." Definitions which make one-third of the population horribly underprivileged picture his purpose and determination for relief.

"Crisis" arguments will be continued. This seems to be the inevitable consequence of the President's personal psychology. Whatever the Executive wants badly becomes to him so important that anything interfering with immediate progress toward the goal creates in the mind of the President a sincere crisis psychology. Industrial programs which neglect this factor in Washington's administration of affairs will be inadequate.

"No New Taxes"

LEADERS in Congress state categorically that the tax bill of this session will not impose new taxes on industry. They even go so far as to promise, in conferences where they may not be quoted by name, that even individual income taxes will not be increased by Congress this session. Washington does not believe them.

But the battle over the excise tax on copper is not disposed of categorically in this fashion. Nor do Washington interpreters with long memory agree that the promise of no new taxes can be taken at 100 per cent. Certainly it is safe to assume, however, that few, if any, taxes will be repealed or reduced. Only two types of tax cut are reasonably expectable:

1. A cut or elimination of the copper excise tax as a punitive measure is quite possible. The reason for this is the recent rise in copper prices.

2. A few of the nuisance taxes, which cost almost as much to collect as they return to the Treasury, may be eliminated; but no officials can be found who will point out any such specific items.

Perhaps most helpful for domestic smelters is the thought that they could get a bigger share of the world refining business if present excise taxes were eliminated. That reasoning, however, includes two flaws: First, refining under bond or reexport with drawback practically now eliminates the tax effect. And second, nationalism in the rest of the world creates a demand for home smelting of ores, or even for control from occurrences through to finished fabricated articles. The United States excise taxes are not big enough to offset that factor when military contingencies threaten daily.

COURT "TRADES"

THE PRESIDENT'S Supreme Court adjustment program may have the Congressional spotlight for several months to come. One of the best informed members of Congress lately said, "We will do well if we vote on it by August."

THE MINING INDUSTRY has certain direct and special interest in this battle through reported current operations of Western Senators. Some of these Senators are sincerely opposed to the President's plan. This has been evident by their public statements, but it has not prevented gossip from charging them with willingness to barter votes. One critic states bluntly that the necessity for Western support in the Court proposal is the one thing which keeps the present silver price bonus and provides good opportunity for establishing other special favors to Western mining. None of this can be proved, but much of it is believed by cynical, critical, inquisitive Washington.

Strategic Reserve

The ore value, duty paid, AT PORTS OF ENTRY *is in each case 41.20c. per unit of contained manganese in 50 per cent ore. The cost of this imported ore* DELIVERED *to various consuming points is indicated on the basis of value at port plus freight rate only. Worth of ore* AT PRODUCING POINTS *as indicated on the chart is calculated as follows: The value at consuming point typically reached is reduced by the freight required to transport 50 per cent Mn ore to that point of consumption. These values do not take into account the cost for mining or beneficiation, nor do they represent sales values, present or prospective. They are in all cases merely equivalent worth as affected by freight rate. The per cent Mn indicated at each producing point is typical content of metal in the grade of ore or concentrate* AS *commonly* SHIPPED *by such producer. Where known to the Bureau the Mn content of* CRUDE ORE *is indicated in parentheses. In most cases these crude ores are not of shipping or marketable grade under present conditions.*

"A RESERVE SUPPLY of prepared and processed strategic minerals of domestic production" would be provided for the Navy Department if a $5,000,000 allotment, proposed by the House of Representatives, were approved. The stated purpose is to arrange purchase of such strategics as manganese in quantities that would constitute something of a military reserve. The object of subsidizing domestic producers is, however, probably more important than the question of preparedness. In its initial action, the Senate did not approve this plan and voted the item out of the bill. As this is written, late in March, the decision of the conference committee is not known.

If manganese were the principal commodity purchased, there is no doubt that the cost for this supply would be much higher from domestic sources than the prevailing supply commonly imported. Were this conclusion not true, the price which domestic producers would have to charge would be very much lower than they have indicated their ability to accept in the past.

The accompanying map shows the relationship between prevailing import prices and equivalent domestic worth at producing points. These data, prepared by the United States Bureau of Mines, take no account of costs or profits. They represent merely equivalent values. In each case the indicated cents per unit of manganese represents what this metal constituent would sell for at the producing point if it were to be delivered at the indicated consuming centers at a price exactly equivalent to the price of imported material, including duty.

Especially in the case of producers that mine ore of low manganese content, it is evident that the return per ton of ore mined would be very low indeed. The cost of mining and beneficiation to marketable grade obviously would exceed these indicated prices. One must conclude, therefore, that such an arrangement as is proposed for the Navy with respect to manganese would be a subsidy on this metal, borne by the tax payers for the benefit of "uneconomic" domestic producers.

Utah "Mines" Station

THE proposed new Mines Experiment Station for Salt Lake City has received a boost through passage by the Senate of the bill authorizing that new agency. Expenditure of $300,000 is contemplated but not actually appropriated by this act.

The Department of Interior communication regarding the matter stated categorically that building such a station at this time was "not in accord with the President's program." But this discouraging comment followed in the same letter a long explanation as to why this station was so important. That argument, evidently from the Bureau itself, was more persuasive on the Senators, especially those of the West who would like additional technologic investigations stimulating development in their territory.

Strangely enough, there is a large Congressional unit favoring such technologic studies despite the unwillingness to support corresponding economic investigations, even when the latter are commonly reported by industry to be currently of much greater value in stimulating both mining and metal or mineral marketing.

Comment on the copper situation in official circles is along this line. It is pointed out, undoubtedly with full justification, that stabilization of non-ferrous metal prices will never be fully accomplished until a complete statistical summary is regularly and frequently available for the guidance of purchasers and sellers alike.

Colorado

Small Producers Grow More Numerous

Activity in Gilpin County steadily increasing—High-grade ore reported found in the Vindicator

▶ H. C. McNeal and Associates have obtained a lease from the Waldorf Gold Mines, Inc., to operate the Waldorf tunnel No. 5 and the 50-ton mill near Georgetown.

▶ The Brown-Zimmerman-Wade lease on the 21st level of the Vindicator mine, recently encountered some rich gold ore in the Lilly vein. A thousand pounds was sorted, said to average 152 oz. per ton. A carload of ore was said to assay 7.90 oz. of gold per ton.

▶ The shipments from the Pati Rosa property now amount to ten cars per week of fair-grade gold ore. The ore is being mined from stopes above the second level, where veins intersect forming an orebody 30 ft. wide and 70 ft. long. Sufficient ore is in sight to maintain steady production for some time.

▶ Lucky Discovery Gold, Inc., operating the National Mine, at the head of Spring Gulch, Gilpin County, has completed surface ore bins and started stoping on the 400 level. Regular shipments are expected to start at once.

▶ The Columbia-Summit Gold Mining Company, Thomas L. Hutchins, president and general manager, is working the Columbia and Summit mines, near the top of Virginia Canyon in the Russell district in Gilpin County. A new shaft has been sunk 250 ft. and completely equipped. Drifting on the vein is now progressing.

▶ The Terminal Gold Mining Company is working under lease the Egyptian mine, near the summit of Quartz Hill. The shaft has been unwatered and repaired to the 700 level. A new orebody has been found on this level that is reported to contain high gold content. Mike Cercek, of Central City, is general manager.

▶ The Atlantic mine, at Hughesville, is being worked under an R.F.C. loan. A good body of silver-lead ore has been opened up in a winze below the 200-ft. level. Shipments made from development are reported to have netted the company over $1,000 per car.

▶ The Crown Point-Virginia mine, at the head of Virginia Canyon, Gilpin County, is being reopened under the direction of Frederick Stroehle. New buildings are being erected and machinery is being installed.

▶ The Colorado Silver Mines, Inc., operating the Coaley and Black Jack mines, above Black Hawk, have completed construction and are now on a production basis. The first car of concentrates from the new mill has been shipped.

The eastern part of the Santa Rita pit of the Chino Copper Company, which is now producing about 10,000 tons of copper ore daily. The large fragment of rock silhouetted in the horizon at the base of the steep bluff is called the "Kneeling Nun."

New Mexico

Chino Copper Plans Production Increase

Primary crushing plant to be assembled near concentrator at Hurley

▶ Daily tonnage of ore treated at the Chino Copper Company's mill at Hurley is about 10,000 tons. As soon as the primary crushing plant has been removed from the mines at Santa Rita and rebuilt at the concentrator, production will be increased to 13,000 tons daily. R. B. Tempest is general manager and H. A. Thorne superintendent in charge of mine operations at Santa Rita, and F. Hodges is mill superintendent at Hurley.

▶ The Peru Mining Company, at Hanover, is producing about 450 tons of zinc ore daily. Ore is crushed and then transported via aërial tramway to the loading station at Hanover and then shipped to the mill at Wemple, near Deming. Dried concentrates are roasted in a Wedge roaster before being shipped to the zinc smelter at Amarillo, Tex. Roaster gases are treated in a small Cottrell plant. K. K. Hood is manager and R. L. Dean mine superintendent.

▶ The Ground Hog unit of American Smelting & Refining Company, at Vanadium, is producing about 6,000 tons of lead-zinc-silver copper ore per month. Lower-grade ore is concentrated at the Black Hawk mill and smelting ore is shipped to El Paso. C. S. Elayer is superintendent in charge of operations.

▶ The Empire Zinc Company is reported preparing to resume operations at the company's zinc mines at Hanover. C. A. Schmidt is general manager, and Carl Moore, mill superintendent.

▶ The Banner Mining Company, in the Lordsburg district, after rehabilitating the old Bonnie mine is now mining 200 tons of copper-silver-gold ore per day. Ore is treated in a new 200-ton mill and concentrates are shipped to El Paso, Tex. E. S. Bowman is general superintendent, William McLendon, mine superintendent, and Willis Lacey, mill superintendent.

PRESIDENT ROOSEVELT HITS COPPER

AT A PRESS CONFERENCE on April 2, President Roosevelt declared that the government would curtail its purchases of durable goods and spend on consumer goods instead to check the rise in commodity prices. He asserted that prices of durable goods have been rising faster than wages, and that this is usually a danger signal. In reference to copper, the President said that some mines could produce copper at a profit for 5 and 6c. a pound and other companies—mentioning Anaconda—could make a profit on sales at 8 or 9c. a pound. Yet, the President continued, copper is now selling at 17c. a pound, pushing up prices in all of the industries into which it enters, and these are mainly in the durable-goods field.

THE 4c. IMPORT TAX also came in for some consideration at the conference. In reply to a question, the President remarked that the existing excise tax has no bearing on the present price of copper. Whether Congress continues this excise, which expires on June 30, 1937, would make little difference, according to the President.

Stripping the overburden in the old "Oronogo Circle". The Oronogo Mutual Mining Company plans to mine the shallow zinc ore deposit with a 1½-cu.yd. shovel and haul the ore by trucks to the railway for shipping.

Tri-State

More Mills Go Into Operation

Rising shipments of zinc concentrates expected during spring months — Muncie mill destroyed by fire

▶ The Muncie mill of the Federal Mining & Smelting Company was destroyed by fire the evening of March 6. The fire originated in the mill derrick located at the south end of the mill and was discovered soon after the mill crew had finished the day shift. Fanned by a strong south wind, the fire soon spread, and the mill building was almost completely destroyed, despite the efforts of fire trucks from Treece and Picher. No definite decision has been reached concerning the rebuilding of the mill, according to L. G. Johnson, district manager of the company.

▶ Oronogo Mutual Mining Company has started stripping operations on the southern end of the famous "Oronogo Circle." A General shovel with a 1-yd. dipper is being used in the stripping operations. The waste material is being removed with 2-ton dump trucks. Stripping operations will cut through a rim of rich lead sulphide and lead carbonate ores, but these will not be mined until the stripping in the center of the pit has been completed, according to Guy H. Waring, one of the owners and manager for the company. About 40 to 50 ft. of shale in the center of the pit, which caved during former operations, must be removed before mining will begin. Mr. Waring expects it to take several months to complete the stripping. The ore will be trucked to a loading ramp and shipped by rail to the Central mill of the Eagle-Picher Mining & Smelting Company.

▶ The United Mines, Inc., will begin operations at the old Easy Money mine, northeast of Diamond, Mo., early in April. The mill was last operated by the Little Chief Mining Company in 1935. A 3-in. and a 4-in. steam pump will be installed to lower the water in the mill shaft, which is 175 ft. deep. George W. Moore, president of the United Mines, Inc., first developed the property in 1931.

▶ Denney Mining Company is dewatering the Hodson-Wakefield lease, just north of its Coahuila mill, which is located several miles northwest of Carthage, Mo. The 600 g.p.m. 7-in. Pomona pump is powered by a V-8 gasoline engine. The shaft, which is 210 ft. deep, will be sunk to 227 ft., according to C. F. Denney, manager. The ore will be trucked to the Coahuila mill for concentration.

▶ Dividend Mining Company expects to start its 100-ton mill, near Spurgeon, Mo., early in April. The mill is powered by a 60-horsepower semi-diesel oil engine. Spurgeon Mining Company has been operating a small mill in the Spurgeon area for almost a year. Frank Hudson and associates are developing a mine 2 miles southwest of Spurgeon. They have a 20-ft. face of zinc ore at the 100-ft. level. A mill will be constructed if further developments are satisfactory.

▶ The Waco camp, on the Missouri-Kansas line north of Joplin, is the scene of much activity. W. F. Evans has taken an interest in the R. H. & G. Milling Company, and the tailing mill on the Acme lease has just been put back into operation after being idle since early in 1936.

▶ St. Louis Smelting & Refining Company is putting down a 16-in. churn-drill hole, in which will be installed a 12-in. Pomona turbine pump, on the Grasselli lease, northwest of Waco. The hole will be drilled to a depth of 300 ft.

▶ C. C. Playter, who operates a custom mill on the Missouri side of the line, has been operating a 7-in. Pomona pump and has lowered the water in that vicinity to 130 ft. Several groups of miners are supplying ore to this custom mill from the shallow levels in this vicinity.

▶ W. F. Evans is installing an 8-in. Pomona pump on the Acme lease, and C. W. Ritter & Associates are sinking a new shaft on the High Five lease and will install a 6-in. pump in an adjoining shaft when the new shaft reaches the water level. Numerous small groups of partners are making preparations to produce ore as soon as the general water level has been lowered.

▶ G. H. & S. Mining Company has put its 250-ton mill in operation in the old Peacock camp, on the Kansas side of the State line between Waco and Galena. The water has been lowered to the 150-ft. level. Shallow workings above the 80-ft. level have been subleased to small groups, and the mill will be operated as a custom mill, according to L. W. Goings, manager for the company.

▶ Bailey Mining & Milling Company, on the O'Neill lease, expects to have its tailing mill back in operation early in April after being idle since last October. Two six-cell jigs and a Butchart flotation machine will be added to the mill. The mill will handle 60 tons of tailings per hour, according to Ralph J. Smith, mill superintendent. A new shovel has been purchased for loading the tailings.

Michigan

Higher Metal Prices Bring Wage Boost

Daily rate of pay based on sliding scale of copper price—Stockholders of Isle Royale Copper oppose liquidation

▶ The board of directors of the Isle Royale Copper Company submitted to the stockholders the question as to whether the company shall be liquidated or corporate existence continued and the property reopened. The annual meeting was held in Boston, Mass., on April 7. A new board of directors was elected, made up chiefly of Paine Webber & Company and Copper Range interests. The new board plans to buy into Isle Royale for long-term investment.

▶ It is expected that the Quincy Mining Company, which is reopening its property, will be ready to hoist copper ore before the end of April. Repairs to No. 6 shaft are about completed. Water-bailing skips are working steadily, in addition to the pumps, and the mine is being unwatered rapidly. Mill and railroad repairs are well under way and will be ready when the mine begins ore shipments.

▶ The Copper Range Company has adopted a wage scale based on the domestic selling price of copper, in consequence of which wage rates were increased 30c. per shift on March 16. Contract rates and salaries have received individual adjustment. When the domestic selling price of copper shall change one full cent, and this full cent has been maintained for 30 consecutive days, the rate of wages

shall change 15c. per shift. Such change will be made effective on the first or sixteenth day of the month following the 30-day period. The increase of 30c. per shift on March 16 covered the increase in price of the metal from 13 to 14c. on Feb. 16 and from 14 to 15c. on Feb. 19. It is mutually agreed between the company and the employees that this plan gives the employees a fair share of the benefit derived from higher copper prices without jeopardizing the ability of the company to continue its policy of adequate development and exploration. Following a custom established last year, the 1,700 employees of Calumet & Hecla Consolidated Copper Company received a "dividend" bonus in March equivalent to 25c. per share on 50 shares of stock. This was paid in conjunction with a dividend disbursement of 25c. a share to stockholders. In addition to the bonus, wages were raised 10 per cent on Feb. 1.

Iron Country

Early Shipping Season Expected

All ships chartered this year to haul ore —Minimum wage at mines now $5 per day and 40-hour week established

▶ The movement of iron ore will start as soon as boats can make their way to the ore docks and all operating mining companies have given orders to have equipment ready by April 10 at the latest. The furnaces are anxious to receive ore, as their stockpiles will be low by the time ore shipping starts.

▶ Beginning March 16 the minimum wage at the mines will be $5 per day of eight hours. A 40-hour week is also established, with time and one-half for overtime. Labor troubles are not anticipated on the iron ranges, and no organizations have been formed as yet to affiliate with any national labor union. The men have a representative organization of their own, and this has been very successful.

▶ The Mahoning mine, at Hibbing, operated by Pickands, Mather & Company, now has a production schedule of 5,500,000 tons for this season. This will be the largest tonnage produced from this pit. Some in the industry predict a total of 60,000,000 tons will be mined in the Lake Superior district for the season of 1937. The greatest worry this year will be that sufficient ships may not be available for some companies, as all bottoms have been chartered and it will be difficult to move any other tonnage than that now estimated.

▶ Charleson Iron Mining Company, of Hibbing, expects to be very active this season. It will operate the Dale-Leetonia mine, at Hibbing; the South Judd, at Taconite; and the Perkins and Northern Pacific leases, at Aurora. The company will move a new 1¾-yd. Marion diesel-electric shovel to Aurora to begin stripping operations as soon as possible.

Mexico

Copper and Lead Exports Steadily Increasing

Demand for base metals abroad spurs mining activity in several districts—More demands by labor are satisfied

▶ Demand for copper and lead in Europe is increasing exports of those metals from Mexico to a considerable extent and keeping mines busy. Several companies recently voluntarily granted workers wage increases. There was less labor trouble during March, though one enterprise was obliged to quit because demands imposed upon it by work regulations made continuing unprofitable. Various companies satisfied labor demands by granting liberal economic concessions.

▶ About 3,000 employees of Cia. Minera el Oro, operating at El Oro, State of Mexico, and Tlalpujahua, Michoacan, accepted an 8 per cent salary cut for 180 days by an agreement which called a truce to labor difficulties that had lasted for some time. Government experts are to determine, within the 180 days, whether or not the company's contention that wages must be lowered is justified.

▶ Cia. Minera La Herradura y Anexas, operating at Real del Monte, Hidalgo, reported to its stockholders that in 1936 production was 135,226 metric tons and that 293 kg. gold and 51,499 kg. silver were recovered. Paul Northey is president of the company.

▶ Copper production taxes have been fixed at percentages contingent upon the New York price basis for the metal at 30 centavos per pound. The levies are to be increased or decreased by every 3 centavos change from that price level. Crude ore will be taxed 2.7 per cent; concentrates, 2.2 per cent; precipitates or bars alloyed with other metals, 1.7 per cent; and refined 1.2 per cent.

▶ The San Francisco Mines of Mexico, in Chihuahua, are now maintaining a minimum daily wage of 4.60 pesos (about $1.28) and have consented to invest $40,000 to afford employees a drinking-water service, 60,000 pesos to found a workers' consumers' cooperative society, 18,000 pesos for employees' social service, 17,000 pesos to run a free medical clinic for workers and their families, and 1,800 pesos monthly for free medical service and medicines for help. The agreement benefits about 2,500 employees.

▶ Credito Minero y Mercantil, S.A., a mining financing bank operated in Mexico City by a syndicate of foreign and Mexican mining men and bankers, is paying a dividend of 12 pesos (about $3.75) a share on its 1936 profits.

▶ Mining and milling operations of The Fresnillo Company, at Fresnillo, Zacatecas, are averaging about 3,500 tons of ore daily, containing gold, silver, lead, zinc and copper. T. C. Baker is general manager.

▶ Preparations to work the Centenario property, in the Guaymas sector, Sonora, are being completed by Cia. Minera Aguila de Oro. J. D. McClintock, of Tucson, Ariz., is general manager.

▶ Early resumption of activities has been made possible for Cia. Minera de Montecarlo y Anexas at Justepec, Oaxaca, with the ending of a prolonged labor dispute.

▶ Minimum daily pay of 5 pesos (about $1.40) for miners and 4 pesos ($1.11) for surface labor has been granted by Potosi Mining, operating at Santa Eulalia, Chihuahua.

▶ Important exports of base metals are being made from central Mexico to Great Britain, Sweden, France, and Japan via Tampico and west coast ports. Lead concentrates exported to Europe through Tampico are reported to have totaled 4,500 metric tons in the last half of February. There has been substantial movement of gold and silver by rail to the United States and Europe.

▶ Higher copper prices prompted Cananea Consolidated Copper, operating at Cananea, Sonora, to establish a minimum daily wage of 6.75 pesos (about $1.80), with voluntary pay increase of 2.50 pesos daily. The wage is said to be the highest daily minimum paid in the Mexican mining industry.

▶ Compagnie du Boleo, a French firm working copper mines in the Santa Rosalia sector, Lower California, has reemployed most of the men it laid off during the depression.

▶ The Zacatecas state government is arranging to place unemployed miners on abandoned mineral lands, which will be worked on a cooperative basis.

▶ A new collective labor contract will be signed with employees if the Cia. Minera San Juanico finds the gold vein it is seeking in the Hidalgo del Parral district, Chihuahua.

▶ Prolonged labor troubles recently forced the Cia. Minera Sabina, a small mining enterprise at Alamos, Sonora, to cease operations. H. Rotschuh, one time chief mechanic, has succeeded H. B. Leggett as general manager.

▶ Ore averaging 12 grams of gold and 180 grams of silver the ton is being treated at the 100-ton flotation mill of Cia Minera Teojomulco, at Sola de Vega, Oaxaca. Regular employees total about 500. Charles E. Pouliot is manager.

▶ Cia. Minera San Jose Garzona, near Sola de Vega, Oaxaca, is arranging to install a 300-ton flotation plant before the fall. A 60-ton plant is now being used which treats ore that averages six grams of gold and 700 grams of silver.

▶ The Asarco Company eliminated labor grumblings at its Charcas unit, San Luis Potosi, by allowing employees various economic benefits, including the annual provision of 30,000 pesos (about $9,000) to finance a savings society which is to pay 6 per cent yearly on deposits.

Canada

Pickle Crow Finds New Vein

Prospecting by diamond drill from the lower level reveals existence of good mineralization—Granby expects to begin production in early summer

▶ Diamond-drilling results determined from holes projected from the 1,200-ft. level of the Pickle Crow mine show the existence of an additional vein. One hole is reported to have cut a vein 6 in. wide assaying close to $30 per ton. Another hole intersected two veins, one said to be 20 in. wide assaying $5.95 per ton and the other vein near by was 12 in. wide reported to assay $215 per ton.

▶ At a meeting of stockholders of the Consolidated Chibougamau Gold Fields, Ltd., on March 22, A. H. McKay, president, announced that result of diamond drilling reported since the first of the year appears to be of sufficient importance to justify a feeling of optimism regarding the future of the property at Cedar Bay. He also said that he would obtain quarterly reports from the Consolidated Mining & Smelting Company, which is maintaining a prospecting and development program on the Consolidated Chibougamau's holdings.

▶ The report of The International Nickel Company of Canada, for the year ended Dec. 31, 1936, shows a net profit of $36,865,526.11 after all charges, including provision of $8,446,639.33 for taxes and $7,814,731.08 for depreciation, depletion, and other purposes. The comparable figure for 1935 was $26,086,527.47 After disbursement of $1,933,898.75 for preferred dividends there remained $34,931,627.36, equal to $2.39 per share on the 14,584,025 shares of common stock outstanding. This compares with $1.65 per share in 1935. The earned surplus rose from $44,094,493.55 as of the close of 1935 to $59,896,143.55 as of Dec. 31, 1936. Cash increased from $30,473,311.32 to $44,871,895.34 during the same period. Commenting on the year's results, Robert C. Stanley, chairman and president of the company, writes: "Throughout 1936, the year under review in this report, your company's business continued to improve. Sales of nickel exceeded those of any prior year and were 30 per cent greater than the volume reported for 1935. Sales of copper and the platinum metals were also substantially greater than in any previous year and better prices for these metals were obtained. Your company's plants were operated at capacity and an all-time peak production of metals was established. From an efficiency standpoint the results were gratifying, and many economies were brought about. On the other hand, wages were increased, working hours were adjusted downward, and higher prices were paid for materials. Furthermore, increases in income tax rates and levies of new taxes took a larger proportion of your company's profits than in preceding years. Extensions to the smelting works at Copper Cliff and the nickel refinery at Port Colborne, together with additions and betterments to plants in Great Britain and the United States, were largely completed toward the close of the year. This expansion program entailed an expenditure of $11,202,265.71 and will increase productive capacity to more than 220,000,000 lb. of nickel in all forms per annum."

▶ Extremely gratifying results were obtained in samples taken from the gravels lying in the pre-glacial gutter of Lightning Creek, Cariboo, which was entered from a test raise during February at the Wingdam camp of Consolidated Gold Alluvials of B.C., Ltd. Extensive diamond-drilling operations have indicated the gravels carry rich gold deposits. The entry into the gravels, which are overlain with a heavy deposit of slum, or Cariboo quicksand, is the first to have been effected in the district, despite numerous and costly attempts. If, as now seems possible through the employment of "deep lead" methods, the obstacle of the slum can be overcome, a new era in placer mining in the Cariboo might eventuate, as it is believed similar deposits exist in other ancient creek beds throughout the district. D. Campbell is general manager.

▶ Wages at the Cariboo Gold Quartz and the adjoining Island Mountain mine were increased March 1 to $5.25 a shift for miners, $4.50 for muckers, and $4 for surface laborers.

▶ A three-quarters interest in the Surf Point mine, on Porcher Island near Prince Rupert, has been acquired from the N. A. Timmins Corporation by the Reward Mining Company. The property is equipped with a 25-ton mill that has been operating profitably for some years and adjoins Reward's Edye Pass group of mines. The joint development of the properties is proceeding under J. D. Galloway, vice-president of Reward.

▶ The Whitewater mine, in the Atlin district near Tulsequa, on the Taku River, has been acquired from the Edward C. Congdon interests of Duluth, Minn., by Polaris-Taku Mining Company, Ltd., recently incorporated as a private company. Mr. Congdon is president; D. C. Sharpstone, of Vancouver, in consulting geologist, and B. B. Nieding is superintendent.

▶ At the Bralorne mine, in the Bridge River district, recent work in the vicinity of the Empire fault has opened a new vein and indicated the faulted portion of two others of major importance. Preparations are now being made to open this area below the 10th level by sinking a shaft from the 8th level, first to the 14th. R. Bosustow, is managing director.

▶ It is learned from A. S. Baillie, general manager of Granby Consolidated Mining, Smelting & Power Company, that the new steam power plant at Princeton will be completed soon, and that production of copper from the Allenby 3,000-ton mill will probably be resumed by the first of June. Output will be at the rate of 1,500,000 lb. a month at the outset, which will be increased gradually to 2,000,000 lb. The power plant will cost about $400,000, and rehabilitation of the mine and concentrator, $200,000.

▶ Results of development to date at the Hedley Mascot mine, in the Similkameen, have confirmed the original estimate of average values—between 0.45 and 0.5 oz. per ton—according to the managing director, R. H. Stewart. Some variation in millheads is expected, as values differ in various parts of the orebodies, and it is impracticable to mine too selectively. With changes now being made in the mill to increase its capacity from 150 to 175 tons daily, profits should average between $45,000 and $50,000 a month. The company recently sold 100,000 shares and has given an option on 200,000, the completion of which would increase cash reserves to over $500,000, with which it is planned to extend explanatory work to other parts of its property.

▶ The sustained high prices of lead and zinc have hastened efforts to reopen a number of properties in the Slocan area. The Kaslo-Nakusp branch line of the C. P. Railway has been cleared after late snowfalls, and supplies are being shipped to the Lucky Jim, Whitewater, and Wellington mines. Development work at the last named was resumed in January, and the immediate resumption of production at the other two mines is planned.

▶ Encouraging results are being obtained at the Gold Belt, Sheep Creek camp, where in the past two years, under the direction of Grattan Lynch, North American Mines Corporation, of Boston, has invested almost $150,000. Three oreshoots have been opened in the 1,500 vein at the 1,850 level, the first averaging 0.31 oz. across 40 in. width for a length of 130 ft., the second carrying an average of 0.85 oz. across 2.5 ft. width for a length of 75 ft., and the third, the lateral extent of which has not yet been determined, averaging 0.45 oz. across 3.2 ft. width for the 55 ft. opened to date.

Bolivia

Tin Recovered From Large Tailing Pile

Four plants are near completion for winning about 60 tons of the metal per month from old tailings

▶ Cia. Minera de Oruro recently acquired control of the Colquiri, Morococala, and Vinto mining companies. The Oruro and Morococalla mines are producing, but the Colquiri mine is being developed and Vinto mills are almost completed. Production from these mines in 1936 was about 1,400 tons of tin and 1,500,000 oz. silver. At Vino there are 10,000,000 tons of old tin tailings which are said to contain ½ per cent tin. Three preliminary concentrators are under construction, totaling 1,000-ton capacity for the treatment of these tailings. Concentrates from these three plants will be pumped to a 100-ton mill delivering a 45

per cent tin concentrate. Concentrating will be done by 100 Denver-Overstrom tables. Only the 100-ton mill will have a grinding section for middlings. Tin recovered from these tailings is expected to amount to 60 tons a month. At Colquiri about 50,000 tons of metallic tin is said at present to be blocked out in 2 per cent ore, and prospects for more are considered good. The San Juanillo adit is now being driven and is expected to connect the ore at 1,400 meters. J. Fredericus van Dorp is managing director of the company, with offices at Casilla 154, Oruro, Bolivia. E. D. Cartier van Dissel is assistant general manager.

Peru

Mining in the Remote Inambari District

Mule trails are being built into this little-explored area in southeastern Peru

▶ Cia. Minera Inambari at Oroya, on the Inambari River, has been following a program of development work in the Santo Dominto Creek. A 1,000-ft. drainage tunnel has been completed and the stream bed will be worked for placer gold and for the recovery of some concentrates and tailings that have been run into San Domingo Creek for many years. Placer mining in this district during the major part of last year was interrupted by heavy rains. A 1½-cu.yd. dragline excavator was installed here, but large boulders in the gravels prevented successful operation of the placer area.

▶ The Inca Mining & Development Company, operating the Santo Domingo mine, is in the little-explored Inambari district, at 10,000 ft. elevation, on the east slope of the Andes in southeastern Peru. The ores from this mine present metallurgical problems, and tests have been made by roasting the concentrates and then treating with cyanide solutions, but gold extraction has not been satisfactory. This problem is expected to be solved following further testing. When mule trails are built above and below the junction of the swift Inambari River, the Santo Domingo trail mining activities are expected to increase. Clarence Wood is president of the company at Tirapata, Peru.

▶ Lead and zinc export taxes have been re-established by executive decree following expiration last December of the law which supended such levies for a period of ten years. When prices of lead and zinc in New York pass 4½c. per pound, the export tax is $1 per metric ton on lead or zinc metal contained in bars, concentrate, or in ore.

▶ Construction of the new lead smelter at Oroya, Peru, by the Cerro de Pasco Copper Corporation is progressing at a good rate. The capacity of the plant will be about 35,000 tons of lead bullion per year, and operations are expected to begin in July of this year.

Norway

Pyrite Ore Production Greatly Increased

New output records made by some mines as a result of curtailment in Spanish pyrite producers—Nickel ore production also rising

▶ The mining industry of Norway was greatly stimulated in 1936 by the decreased production of pyrites from Spanish mines. The Lokken and Stord mines of Orklo Grube-Aktiebolog, of Meldalen, made new records, and Bjorkaasen pyrite production also was increased. It was the first time in history that Norwegian pyrite producers exported more than a million metric tons of ore. Lokken mines produced 520,000 tons, 300,000 for export and the remainder treated in the Orklo-Metal plant, recovering 70,000 metric tons of sulphur and 15,000 tons of copper matte. Foldal mines is enlarging its flotation plant. About 135,000 tons of pyrite concentrates are recovered annually by flotation in Norway. No new pyrite mines were opened during 1936, but the government subsidized the development work at the Ringvassoy deposits, in Troms.

The Sulitjelma mines accounted for about 80 per cent of the copper ore produced during 1936. About 6,500 metric tons of copper was recovered from cupriferous pyrites in 1936. Total blister copper produced during the year was about 18,000 tons. The new Bogen mines, in Ofoten, produced in their first four months' operation 8,500 tons of copper concentrate. Production this year is estimated at 50,000 tons of concentrate. Nickel is mined by Raffineringsverket in the Evje and Hosanger mines, where the production was little changed from the figures for 1935.

Increases are reported for zinc and lead output, with Foldal, Bjorkaasen, and Mofjell mines accounting for higher production. Sulitjelma, the major zinc producer, did not step up operations and accounted for 6,500 tons of zinc concentrates. Higher prices for lead and zinc stimulated interest in these metals. Molybdenite, titanium, and graphite all showed increases for the year. Silver production is estimated at 6,600 kg., against 8,400 kg. in 1935. Interest in new and old metal deposits is increasing and new interprises are being planned. The "Iron Plan" for the utilization of the Grong pyrite deposits in connection with the Glomfjord hydro-electric power now has a commission studying the plan.

During 1937 there will be revision in the existing wage rates for Norwegian mine workers. Increased cost of living and higher profits make the demands of the workers appear partly justified. But it must also be remembered that the present prosperity is to some extent artificial. Although the mining companies are enjoying a certain prosperity at present, the many lean years through which they have just passed have depreciated their plants and eaten into capital funds and financial resources. A good deal of the present surpluses must therefore be set aside for modernization, improvements, development work, and the creation of reserve funds.

Norwegian Ore Production

Year	Metric Tons of Pyrite Ore	Copper Ore, Tons	Iron Ore Concentrates, Briquettes, Tons	Nickel Ore, Tons	Zinc and Lead Ores, Tons	Molybdenite (100%), Tons	Titanic Iron Ore, Tons
1913	441,291	70,349	544,686	49,990	897	12	.....
1930	730,951	25,045	722,423	29,084	11,462	284	7,600
1931	359,951	14,604	574,887	15,242	14,871	223	5,000
1932	727,020	18,376	373,907	23,363	17,663	329	13,481
1933	865,576	22,093	473,863	23,614	18,789	414	23,213
1934	960,898	23,374	567,414	29,213	13,238	244	26,306
1935	893,513	25,821	765,152	31,471	12,919	647	37,984
1936	1,035,000	25,900	822,000	32,000	15,500	700	68,300

Fiji Islands

Ore Reserves Gain In Viti Levu

Ore treatment plants going up as Island is fast developing into a gold producer.

▶ Emperor Mines, Ltd., at Tova Tova, Island of Viti Levu, is now producing about 2,000 tons of ore per month. Foundations for the new mill have been completed and construction of the plant is now under way. Capacity will provide for 12,000 tons monthly. Development so far has determined ore reserves estimated to be about 720,000 tons of 10-dwt. ore. All except 50,000 tons is said to be oxidized. George J. Gray is manager.

▶ The Loloma Gold Mines, on the same island as the Emperor lode, is also erecting a mill whose capacity will be 2,000 tons of ore monthly. The ore is mostly sulphide carrying pyrite and telluride (Nagyagite, sulpho-telluride of lead and gold), and about 120,000 tons is blocked out assaying 1½ oz. gold. W. J. Doran is mine manager.

▶ Operations of the Koroere Gold, N. L., also at Tova Tova, is reported to have developed 70,000 tons of 4-dwt. ore and 30,000 tons of ½ oz. gold ore. The Koroere area adjoins the Emperor gold mine on the south. G. Ramsay is manager.

▶ Prospecting and development being done on a small area known as The Block, where 63,000 tons of 8-dwt. ore is said to be determined. Samples from this area have been sent to Oakland, Calif., for finding the best method of treatment. Pat Costello, with offices at Suva, is in charge of operations.

Africa

Kansanshi Copper Mine May Reopen

Property in Rhodesia, closed in 1932, expected to resume operations—Mines in Gold Cost area more active

▶ Resumption of productive operations at its Kansanshi mine is being considered by Rhodesia-Katanga Company, Ltd. About 11,000,000 tons of 4.34 per cent copper ore (mixed oxides and sulphides) and 0.4 dwt. gold per ton have been proved in the property by development and diamond drilling. Production will have to be preceded by the erection of a complete plant. Sir R. Williams & Company is manager for the company, with offices at Kansanshi, Northern Rhodesia.

▶ Mufulira Copper Mines, Ltd., is taking advantage of the high price of copper and low interest rates to retire its outstanding £1,500,000 of 5½ per cent debentures. Sufficient of its shares will be purchased by the three companies which own its entire capital stock, Rhodesian Selection Trust, Rhokana Corporation, and British South Africa Company, to provide Mufulira with £1,900,000 of cash. This will enable it to redeem its debentures at 104½ per cent and leave it with over £300,000 of additional working capital.

▶ The Ashanti-Adowsena (Banket) Goldfields, in the Gold Coast area, reports that the 23,797 tons of ore milled up to the end of 1936 had yielded £34,865 worth of gold. The capacity of the plant is now being brought up to 6,000 tons a month and will be later increased to 10,000 tons. South Banket Areas, also in the Gold Coast, has just acquired £35,000 of new working capital through one-half of an option on shares being exercised by Gold Coast Banket Areas and Federated Trust & Finance (the remainder of the option being extended a further year), and is having its ore reserves recalculated and resampled to ascertain whether the erection of the first unit of a mill is justified.

▶ The work of simplifying the rather complicated and unsatisfactory mining layout of Ariston Gold Mines is progressing. The new vertical shaft is now below the 500-ft. level and the mine hoists are in operation. Four new flotation cells have been installed in the mill and others ordered. A plant for the re-treatment of approximately 200,000 tons of old slimes, averaging 2 dwt. of gold per ton, has been purchased.

▶ De Beers Consolidated Mines announces that productive operations will be resumed at the long-idle Bultfontein Mine on July 1, a largely increased output being justified by the growing demand for diamonds.

▶ Nchanga Consolidated Copper Mines has been formed with a capital of £5,000,000 in £1 shares. This is the Rhokana Corporation subsidiary which is acquiring the Nchanga and Nchanga-West properties. Rhokana will control the new company, and is supplying the initial working capital of £400,000. A further issue of 2,500,000 shares of Nchanga Consolidated will be offered immediately to Rhokana stockholders in the ratio of one for each one held at £1 a share. The work of dewatering Nchanga-West workings and reconditioning the plant has been in process since last November. It will be years before production begins. The magnitude of the undertaking is indicated by the cash capital, over $14,000,000, that is being supplied at the outset, and the confidence in the outcome by the fact that Rhodesian Anglo American and Rio Tinto companies have agreed to take, without commission, any of the shares not subscribed. It is apparent, indeed, that these two companies and Rhokana Corporation will take something like two-thirds of the Nchanga Consolidated shares to be offered for cash and be the owners of over 80 per cent of its capital.

PROSPECTING BEGINS IN ETHIOPIA

EAST AFRICA Mining Administration is the new Italian government agency established during March by royal decree to prospect and mine ores of Italian East Africa. Since the major operations will be in Ethiopia, headquarters are to be at Addis Ababa, with branches located elsewhere through the new African territory acquired by Italy.

AN ITALIAN-GERMAN mining company has also been established for somewhat similar purpose, with Italy reserving the right to purchase the German share of the holdings in this enterprise after five years. This commercial venture is planned to prospect principally for copper, lead, iron, and coal, according to official reports to Washington. It is contemplated that the German group interested in this enterprise will furnish much of the technical personnel required, for the reason that, according to the report, "a sufficient number of mining engineers is not available in Italy."

INITIAL CAPITAL for Compagnia Mineraria Ethiopica is to be 20 million lira. Subscribers are supposed to include some of the largest Italian industrial and chemical concerns, which, according to "African World," include Montecatini, Pirelli, Fiat, Montevecchio, Ilva, Minerario, Valdarno, and Montemiata. The Italian Government share in the profits of this enterprise will rise from an initial 25 per cent to a maximum of 50 per cent, according to a fixed scale agreed upon between the promoters and the government.

▶ Licenses to prospect for tin in Burma, suspended in February, 1934, are to be resumed April 20, 1937.

South Africa

Manganese Exports Increasing

Demand for high-grade production from South African mines shows sharp advance—Rising costs being felt in the gold industry on the Rand

▶ South African manganese exports are continually rising, according to latest available statistics. Whereas only 11,615 short tons of manganese were exported from the Union during the first three months of 1936, at least 56,000 tons left Durban during January, February, and March of this year. One company alone, the Associated Manganese Mines of South Africa, has already concluded sales for shipment during 1937 of 285,600 short tons. This company has entered an agreement with the Conference Lines to carry the greater part of the tonnage at fixed prices. Several manganese-producing companies state that the demand for high-grade South African manganese is general from all over the world.

▶ The coming budget speech of the South African Minister of Finance is not expected to contain alterations in the existing mining taxation. With the advent of several new producers during the current year, and many more expected to start production in the next few years, the position has arrived when the industry is likely to ask whether some measure of relief cannot be granted to it in view of its new burden of rising costs.

▶ One of the most famous South African gold mines, the old Sheba mine, at Barberton, will soon be reopened. The Bailey Group has acquired the shareholdings in a company which owned the Sheba mine, and it is interesting to recollect that Sir Abe Bailey, chairman of the Bailey Group companies, was a Barberton pioneer at the end of the last century.

▶ The year 1936 was the best one for South African diamond producers since 1929, and still better results are anticipated in 1937. Conservative observers estimate sales in the Coronation year at over £10,000,000.

▶ Mining in South-West Africa is now definitely on the upgrade, and although a mandate over the territory has been given to the Union, Germany apparently continues to get the benefit from several mining ventures in its former colony, especially so far as raw materials for armaments are concerned. The South-West Africa Company's vanadium producers are selling their ore—mostly to Germany—as fast as it can be produced, and their mines at Abenab and Baltice are reported to be at present working at capacity.

Australia

Titanium To Be Recovered From Beach Sands

Deposits in New South Wales will be exploited by new company—Mount Lyell Mining to increase capacity at copper refinery

▶ A new company, Australian Titan Products, Pty., Ltd., has been formed with a capital of £100,000 to manufacture titanium white from ilmenite. Vast supplies of this mineral exist in beach-sand deposits in New South Wales, Queensland, and Tasmania. The company is a subsidiary of British Titan Products, Pty., Ltd., the leading English manufacturer.

▶ Mount Morgan, Ltd., Queensland, has located a new sulphide orebody on the 285-ft. level. Driving to date has shown a length of 380 ft. with an average assay of 6.9 dwt. The maximum width is 105 ft. A. F. McAskill is general manager and T. M. Owen is technical advisor.

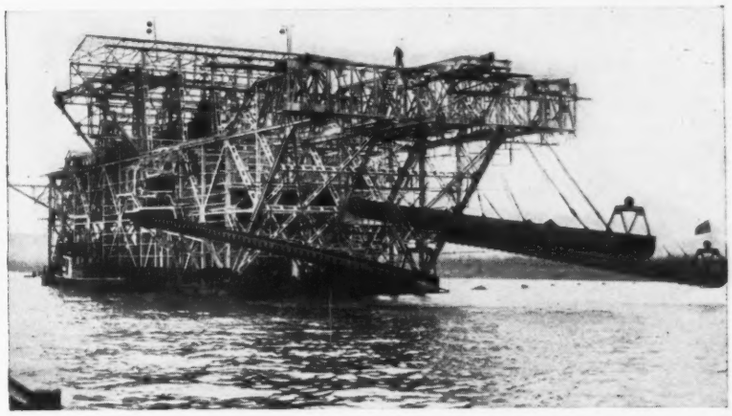
▶ Triton Gold Mines, N. L., Triton, W. A., is to increase its milling plant to treat 9,000 tons monthly (present capacity 6,500 tons). Ore reserves are 217,000 tons assaying 7.5 dwt. A. A. McLeod is superintendent of operations.

▶ Gold Mines of Kalgoorlie, Ltd., has placed orders for its new milling plant, which will have a capacity of 8,000 tons monthly. Ore reserves at March 31, 1936, were 210,000 tons assaying 7.4 dwt. J. F. Thorn and R. F. Playter are technical consultants at Kalgoorlie.

▶ Mount Magnet Gold Mines, Ltd., Mount Magnet, is to double its cyanidation mill capacity to 8,000 tons monthly. For the twelve months ended June 30, 1936, the company made a profit of £13,574. T. Peart is mine manager.

▶ Marvel Loch Gold Development, N.L., Marvel Loch, W. A., treated 25,885 tons during the seven months ended Dec. 31, 1936, for 4,716 oz. gold, valued at £38,126. The treatment plant has been remodeled and now has a capacity of 4,500 tons monthly. By spending £12,000 on a ball mill and classifier and minor plant additions, the capacity could be increased to 7,000 tons monthly, thereby reducing operating costs. Blocked-out ore totals 43,000 tons, of which 12,000 tons below the 200-ft. level assays 9 dwt. and 31,000 tons assays 5 dwt. Four winzes below the 200-ft. level are in sulphides which can be treated satisfactorily in the company's existing plant. Ernest Bails is general manager.

▶ Lomah (Rhodesia) Gold Mines, Ltd., an associate of the Paringa Mining & Exploration Company, has met with favorable results in boring on the Hanna's Reward and Mount Charlotte leases at the west end of the Kalgoorlie field. Four holes have shown the existence of five main lodes continuing to 1,000 ft. in depth and over a strike length of 1,000 ft. There are two shafts to 500 ft., with five levels. These bodies are to be developed by a new company, Mount Charlotte (Kalgoorlie) Gold Mines, Ltd., which will have a capital of £200,000 in 2s. shares.



A terrific storm in the English Channel capsized the world's largest tin dredge on March 8, shown above as it was being towed from Rotterdam for Banka, East Indies. Capacity of the dredge was 720 cu.m. per hour, and its weight 3,850 tons. On March 11 the dredge was floating upside down near Plymouth, England.

▶ Paringa Mining & Exploration Company, Ltd., Kalgoorlie, expects to make a working profit of £50,000 annually when the new flotation plant, having a capacity of 5,000 tons monthly, is in operation. This plant may be extended later as ore reserves (107,660 tons assaying 6.0 dwt.) are increased. T. W. Greenhill is the mine manager.

▶ Cocks Eldorado Gold Dredging, N.L., operating a 12-cu.ft. all-electric bucket dredge at Eldorado, Vic., is obtaining improved yields. For the four weeks ended Jan. 22, 171,000 cu.yd. was treated for 387 oz. of gold and 5.5 tons of tin oxide. Costs are 2.8d. per cubic yard, showing a good profit margin.

▶ Zircon Rutile, Ltd., the company formed several years ago to recover by flotation the zircon from beach sands at Byron Bay, N.S.W., has resumed production after being idle for six months. The sand contains 64 per cent zircon, 18 per cent rutile, and 9 per cent ilemite. Difficulties in marketing the output have hampered the company.

▶ Net profit of £62,214 was won by New Occidental Gold Mines, N.L., Cobar, N.S.W., for the twelve months ended Nov. 30, 1936. The cyanidation plant treated 72,104 tons ore assaying 7.8 dwt. per ton and recovered 24,005 oz. Ore reserves are 375,000 tons assaying 8.5 dwt. per ton to the No. 10 level. Recently the company purchased the New Cobar mine, at Cobar, N.S.W., and plans to erect a flotation plant to treat 6,500 tons of ore monthly. The existing New Occidental cyanide plant has a capacity of 7,500 tons monthly. The New Cobar mine contains 295,000 tons to 500 ft., of which 102,000 tons is blocked out and assays 7.3 cwt. gold per ton and 1.75 per cent copper. V. G. Martin is manager.

▶ Mount Bischoff Tin Mining Company, operating at Mararah, Tas., made a net profit of £3,186 for the year ended Dec. 31, 1936, compared with £7,908 in 1935 and £9,411 in 1934. Ample ore supplies at this famous mine, which since 1872 has provided 82,250 tons of tin oxide, are available for many years' operation. T. G. Traynow is manager, with offices at Wesley Chambers, Lounceton.

New Zealand

New Company Will Dredge Blackwater River

Gold dredge will be operated by electrical energy received from Lake Coleridge

▶ Grey River Dredging Company, Ltd., has been formed, with a capital of £300,000 in 10s. shares, to place a large bucket dredge on the Blackwater River in the Mawheraiti district, West Coast, New Zealand. The area embraces 8 miles of river flats and consists of 1,700 acres. Average depth of wash is 28 ft., minimum 15 ft., maximum 43 ft. Drilling has proved 63,000,000 cu.yd. containing 2 grains of fine gold per cubic yard, valued at 6.90 per cubic yard, recoverable, New Zealand currency and based on fine gold at £8 15s. 0d. per ounce. The dredge will have 16-cu.ft. buckets and will dig 4,500,000 cu.yd. per annum. It will be operated by electric power from the Lake Coleridge government hydro-electric plant, at a cost of 0.5d. per unit. The dredge is estimated to cost £137,000. Costs are estimated at 3.30d. per cubic yard, including overhead and gold export tax. Annual net profit is estimated at £54,500.

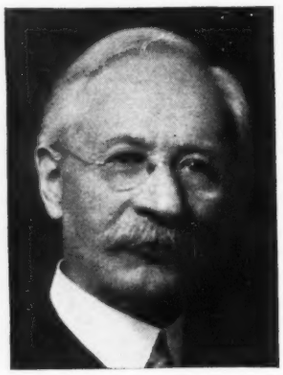
PERSONAL ITEMS

Prof. Charles P. Berkey, secretary of the Geological Society of America, and long head of the department of geology at Columbia University, was tendered a testimonial dinner by his friends on his seventieth birthday on March 25 at the Hotel Astor in New York. In all, 274 people were present, and of those who could not be there, more than 600 sent letters and messages of congratulation, these coming from all parts of the world. Prof. J. K. Finch, head of the department of civil engineering at Columbia, was toastmaster.

The speakers were six in number. "Builder of Men" was the keynote of R. S. Knappen, oil geologist of Tulsa, Okla., and a former student of Dr. Berkey's. "Educator" was the theme of Dr. George B. Pegram, formerly dean of engineering at the University and now dean of the graduate school, who followed.

John L. Savage, who is chief designing engineer of the Bureau of Reclamation, at Denver, Colo., was to have spoken next on "Reclamation Service" in recognition of Dr. Berkey's services as consulting geologist on notable dam construction projects, including Boulder, Grand Coulee, Seminoe, Parker, and various others. Unable to be present, Mr. Savage was represented by Prof. A. K. Lobeck of Columbia University, who on behalf of the Reclamation Service, presented the guest of honor with a unique desk set composed of polished pieces of concrete and foundation rock from both Boulder and Grand Coulee, flanked by pieces of drill cores from the latter. This was accompanied by paper-weights composed of portions of the masonry and foundation rock of the Seminoe and Parker dams. The list of dam construction projects on which Dr. Berkey has acted as consultant is said to be a lengthy one. The next speaker was Thaddeus Merriman, consulting engineer of the New York Board of Water Supply, who, taking "Kaaterskill" as his theme, referred to Dr. Berkey's work as consultant on the great Catskill Aqueduct, which supplies New York City with its water.

Next to speak was Dr. Roy Chapman Andrews, explorer, whose topic was likewise "Explorer" and who dealt with Dr. Berkey's work in 1922 and 1925 as chief geologist of the Central Asiatic Expedition conducted to Mongolia by Dr. Andrews. The latter dwelt on Dr. Berkey's endurance and cheerfulness on these occasions, and on the tireless persistence with which he prosecuted his study of the geological problems that arose. Dr. W. O. Hotchkiss, now president of Rensselaer Polytechnic Institute and vice-president of the Geological Society of America, speaking for the Society, talked on "Yesterday, Today and Tomorrow." The initial letters of the themes of the various speakers spelled out "Berkey" as readers may have noted. The menu of the occasion was novel, recalling in the names of the dishes, which were arranged, so to speak, in "chronological" order, the outstanding events of Dr. Berkey's life, beginning with his birth on a farm in Goshen, Ind.



DR. CHARLES P. BERKEY

Bergassessor Wilhelm Hoelling is head of a distinguished party of more than 50 engineers and executives of German companies concerned with coal, iron, and copper mining, who, as members of Wirtschaftgruppe Bergbau, are just completing a study-tour in the United States. They arrived in New York on the S. S. Bremen on March 31 and will return by the same boat on April 17, after having visited the anthracite and bituminous fields of Pennsylvania and the Lake Superior Iron and Copper Country. While in New York they were tendered a reception and luncheon at the Waldorf-Astoria, the mining profession in the United States being ably represented among the speakers by Karl Eilers, vice president and treasurer of the American Institute of Mining and Metallurgical Engineers. The Wirtschaftgruppe Bergbau includes all German mining companies within its membership. Dr. Hoelling is chief managing director of the organization. The party included the following, alphabetically arranged:

Bergwerksdirektor Siegfried Bammel, Bergassessor Wilhelm Berkenkamp, Bergassessor Friedrich Carl Bertram, Generaldirektor Dr. Otto Berve and Frau Elisabeth Berve; Bergwerksdirektor Dr. Ing. Ernst Brandi, Bergassessor Dr. Ing. Hermann Edler von Braunmuehl, Bergdirektor Arno Bretschneider, Bergreferendar Bernhard van Buerck, and Dr. Ing. Georg Dresner.

Bergwerkdirektor Dr. Fritz Eulenstein and Frau Kaethe Eulenstein, Bergassessor Dr. Richard Forstmann, Bergassessor Ernst Fromme, Oberingenieur Arthur Goehlert, Bergrat P. F. Hast and Frau Anneliese Hast.

Graf Kraft Henckel von Donnersmarck, Graf Karl Erdmann Henckel von Donnersmarck, and Graf Guido Henckel von Donnersmarck; Bergassessor Paul Heiermann, Bergassessor Ernst Herrmann; Generaldirektor Dr. Ing. Carl Hold, Frau Alma Hold and Frau Marga Hold; Dipl. Bergingenieur Eduard Hueck, Dipl. Bergingenieur Hartwig Hueser, Bergbeflissener Ernst Keil, Bergassessor Walter Kiel, Bergwerksdirektor Dipl. Bergingenieur Ernst Lueder, Bergwerksdirektor Hans Nathow, Dipl. Bergingenieur Oskar Puzicha.

Bergassessor Erich Redeker, Bergassessor Carl Reiss, Generaldirektor Johannes Robert, Bergwerksdirektor Hermann Rohne and Frau Lucie Rohne, Bergassessor Dr. Wilhelm de la Sauce, Bergassessor Wolfhart Scharf, Bergwerksdirektor Dr. Otto Schmidt, Oberbergrat Dr. Ing. Erich Schreiber and Frau Sidonie Schreiber, Bergassessor Emil Schroedter, Bergassessor Ernst Schulze-Hoeing, Generaldirektor Kurt Seebohm, Bergassessor Alfred Steffenhagen and Frau Hedwig Steffenhagen, and Dr. Graf Friedrich zu Stolberg-Stolberg.

Dr. Ing. Rudolf Voss and Frau Margarete Voss, Dr. Freiherr Friedrich Waitz von Eschen, Bergwerksdirektor Gustav Weinholz, Hermann T. Wolff, and Ing. Max Zadra.

Glenn L. Allen has left Bolivia and will return to the United States by way of New York.

John S. Stewart, consulting metallurgist, has recently been visiting lead smelters in the Middle West.

A. W. Allen has left New York for the Far East. He expects to return to California early in June.

Dr. G. F. Flaherty has been appointed consulting geologist for Dempsey-Cadillac Gold Mines, Ltd.

C. Erb Wuensch, manager of the Ore Development Corporation, spent several weeks in New York during March.

A. C. Melting has been appointed general superintendent of the Benguet Exploration Company, Inc., Baguio, P. I.

Lee D. Dougan, mining engineer, has opened an office for consulting work at 916 Federal Building in Toronto, Ont.

H. P. Dickey has assumed the direction of operations at the Gold Eagle property, in the Red Lake district of northern Ontario.

Richard H. Vail, who is engaged in consulting work in York, S. C., has been in New York recently, following a trip through the Caribbean.

Landon F. Strobel, who has been in charge of an asphalt rock-mining enterprise in Kentucky for some time past, is in New York temporarily.

Donald F. Irvin has returned to New York from Cuba, where he visited Minas de Matahambre, in Pinar del Rio. That property is operating steadily.

Nathan E. Tanner has become Minister of Mines for the Province of Alberta, Canada, succeeding the Hon. **C. C. Ross**, resigned.

Guido R. M. del Giudice will leave the faculty of the School of Mines, Columbia University, on July 1, 1937. He will become associated with Pennie, Davis, Marvin & Edmonds, patent attorneys of 165 Broadway, New York. Mr.

GUIDO R. M. del GIUDICE

del Giudice will be located in the Washington office of the firm for the next year or so. Mr. del Giudice has been a contributor to *Engineering and Mining Journal* on several occasions.

M. C. Lake, consulting geologist, of Duluth, Minn., has recently been visiting important mining properties in Arizona.

H. C. McCloskey has been elected vice-president of Lamaque Mines, Ltd., which is operating a gold property in northwestern Quebec.

L. H. Boyd, mining engineer, of Los Angeles, has joined the staff of Developments, Inc., at Manila, P. I., as field engineer and geophysicist.

Gordon M. Hutt has been elected chairman of the Winnipeg branch of the Canadian Institute of Mining and Metallurgy.

Philip M. Malouf has become general manager of Scott Chibougamau Mines, Ltd., operating in the northwestern part of Quebec.

W. A. Sterling, of Coleraine, Minn., superintendent of the Canisteo Mine for the Cleveland-Cliffs Iron Company, is on vacation in Florida.

Frank A. Forward, professor of metallurgy at the University of British Columbia, is in the Orient on leave of absence.

Max H. Barber, district superintendent for the Cleveland-Cliffs Iron Company, is making a motor trip to Texas and other southern states.

Richard Samson has resigned as engineer with Tri-State Zinc, Inc., and gone to Mascot, Tenn., where he will be associated with the American Zinc, Lead & Smelting Company.

Fred Flink, until recently with Butler Bros. at Crosby, Minn., has accepted a position with the Charleson Iron Mining Company as engineer in Hibbing.

J. A. MacKillican, manager of the Meridan Iron Company, Hibbing, Minn., accompanied by Mrs. MacKillican, has sailed for Honolulu to spend a few weeks.

W. G. McDunnough, who was employed by Butler Bros. for several years on the Cuyuna Range, has been appointed Director of the Duluth District as WPA administrator.

Earl Mollard, connected with Butler Bros. at Cooley, Minn., has been transferred to the Merritt mine, at Trommald, Minn. Mr. Mollard will have charge of operations at this mine.

H. M. Lavender has succeeded **P. G. Beckett** as general manager of the Phelps Dodge Corporation. Mr. Beckett has been made a vice-president of the Corporation.

Lucien Eaton, who recently returned from examination work in Nicaragua, writes that he killed seven hogs with five shots as one of the incidents of this trip.

W. F. Neals is leaving the United States for South Africa to become plant designer for the South African Copper Company, O'Okiep, Namaqualand.

Robert Douglas, mining engineer and geologist, is now in charge of the operation of the property of Clark Gold Mines, Ltd., at Dynent, northwestern Ontario.

Paul Billingsley, geologist, addressed the Utah Chapter of the A.I.M.E. at Salt Lake City on March 18 on the progress of gold mining at Goldfield, Nev.

George Brown, formerly chief clerk for the Corrigan McKinney Steel Company and located at the Stevenson mine, has accepted a position in the offices of the Charleson Iron Mining Company.

C. O. Stee, mine manager of Siscoe Gold Mines, Ltd., has been engaged as consulting engineer to collaborate in the development of Jacola Gold Mines and Siscoe Extension, operating in the northwestern area of Quebec.

C. C. Freeman, formerly superintendent of Zinc Corporation, Ltd., Broken Hill, N.S.W., returned to Australia from London in February. He will engage in consulting work.

William A. Newman, mining engineer, of Berkeley, Calif., has resigned his position with Oak Bottom Placers, Inc., and left for Colombia, S. A., to join the staff of Pato Consolidated Gold Dredging, Ltd.

H. J. Morgan, metallurgist, of Los Angeles, Calif., has been placed in charge of the testing laboratory opened at Walnut Park, Calif., by Penhoel-Menardi Engineering Company, of Los Angeles.

F. J. Liska, of Chicago, president of the Gold Standard Mines Corporation, operating in the Katherine district, Mohave County, Ariz., is spending a month at the mine and mill.

Victor Stevens, formerly on the staff of the Climax Molybdenum Company, is now employed in the mine engineering department of the Miami Copper Company, operating in Miami, Ariz.

J. P. Hart, director of the School of Mines at Tonopah, Nev., for the past five years, has been appointed general manager of Austin Silver Mining Company, at Austin, Nev.

J. B. Tyrrell has resigned from active participation in the management of Northern Canada Mining Corporation and the Kirkland Lake Gold Mining Company, though still continuing to occupy the position of president of both companies.

Russell C. Fleming, mining engineer, recently left the United States for the Philippines, where he will assist Dr. **H. Foster Bain** in the establishment of a Bureau of Mines for the Islands. **Andrew Leith**, of the University of Wisconsin, will act as geologist on the staff of the new Bureau.

S. E. Stein, metallurgical engineer, has been made manager of the recently organized Southwestern Engineering Company of the Philippine Islands, Inc. The *Baguio Bulletin*, published in Manila, has been printing in installments an article on "Fundamentals of Ore Milling," written by him for laymen.

L. E. Sinclair, formerly mine superintendent for the Société la Tiebaghi, in New Caledonia, and later field engineer for Mount Isa Mines, Australia,

L. E. SINCLAIR

has been appointed manager of the New Caledonia properties of the Société Chimique du Chrome.

Frederick G. Sefing, recently assistant professor of metallurgy at Michigan State College, has joined the laboratory staff of the International Nickel Company as a research metallurgist. **Donald J. Reese**, a graduate of the University of Michigan, has also joined the company's staff at Bayonne, N. J., as research metallurgist.

Ralph Shimmin, until recently employed by the Sunshine Mining Company at Kellogg, Idaho, is now mill superintendent of the Galena Mill of the Callahan Lead-Zinc Company, at Wallace, Idaho.

G. P. Lipsey, formerly assistant mine superintendent of Britannia Mining & Smelting Company, has been appointed general superintendent of the Howe Sound Company, Chelan division, Lucerne, Wash.

M. I. Leydig, who has spent the past six weeks at Zortman, Mont., assisting in the operation of the Ruby Gulch mine, has returned to Pony to reopen the mill at the Atlantic & Pacific Mine. The latter mill closed down about the first of the year owing to adverse winter weather.

W. H. Christie, of Emeryville, Calif., was made a Senior Member of the A.I.M.E., at the meeting of the Institute on March 19 in New York City. The distinction was in recognition of Mr. Christie's contribution of books to the library of the San Francisco Section.

Paul W. Avery, formerly with the Amparo Mining & Exploration Company, and general consultant in metallurgy, has been appointed assistant general manager of the Lane Rincon Mines, Inc., near Temascaltepec, State of Mexico.

Dr. J. F. Walker, former Provincial Mineralogist for the British Columbia Department of Mines, has been appointed to the dual office of Deputy Minister of Mines and Provincial Mineralogist. Prior to joining the Provincial Government, several years ago, he was a member of the staff of the Geological Survey of Canada.

Philip B. Freeland has been appointed Chief Mining Engineer for the Province of British Columbia, **R. J. Stevenson** Chief Clerk and Chief Gold Commissioner, and **Patrick J. Mulcahy** Mining Recorder for the Victoria Mining Division.

George A. Edwards, formerly mine foreman of the Tom Reed Gold Mine at Oatman, Ariz., has accepted a position with the Miami Copper Company, at Miami, Ariz., where he was employed for five years prior to 1929, when he took over the Van Dyke copper interests, serving in the capacity of superintendent.

Frank Ebbutt, who has been geologist for Britannia Mining & Smelting Company at Britannia Beach, British Columbia, since 1924, has moved to 173 Glenrose Ave., Toronto, Ontario. He is to carry on exploration and examination work in Eastern Canada for the Howe Sound Company.

Merle H. Guise, who specializes in gold placer examinations, is returning to Fairbanks, Alaska. Last year he examined Peters Creek, in that territory, and designed and installed a washing plant for the creek, which was so profitable that he is considering a similar outfit this spring for the Fairbanks district.

Albert Mendelsohn, general superintendent of mines for the Copper Range Company in the Michigan copper district, recently resigned and left on April 1 for Mexico to become assistant general manager of the Greene-Cananea Copper Company, a subsidiary of Anaconda. A graduate of Columbia University, Mr. Mendelsohn has been with the Copper Range Company since 1912.

Wing G. Agnew is acting as resident engineer in charge of investigations being conducted by the United States Bureau of Mines at Mount Weather, Va., having for their objective the improvement of underground mining conditions. The proposed studies will include those concerned with the improvement in underground working conditions with regard to the causes and prevention of dust; research in blasting, and with respect to gases formed by various types of explosives after blasting; ventilation of mine openings; and related subjects.

C. E. Nighman, of Boise, Idaho, has been appointed superintendent of the Jardine Mining Company, at Jardine, Mont., replacing N. W. Emmons, resigned. Mr. Nighman was for many years associated with the Anaconda Copper Mining Company, having been the first superintendent of the Conda Phosphate Mine, in Idaho, and later he was active in Anaconda's Polish enterprises. The Jardine property was recently acquired by **William Hay** and associates, of New York. Previously the property was for many years under the supervision of **Harry Bacorn, now,** with his family, on a world cruise.

OBITUARY

Alexander Jerome McAllister, president of Central American Mines, Ltd., died on March 16 at San Miguel, Republic of Salvador.

Horace B. Church, Jr., secretary of the Cortez-King Brand Mines Company, died on March 13, in Jefferson City, Mo. He suffered a heart attack while driving his automobile homeward.

Samuel W. Thompson, of the firm of Thompson, Weinman & Company, of New York, miners and manufacturers of non-metallics, died on March 27 at the age of 73.

Herman J. Rossi, 67, mayor of Wallace, Idaho, and pioneer business man of the Coeur d'Alenes for 47 years. died on March 12. He was president of several mining companies.

Louis D. Rasor, mining engineer, and United States surveyor in Los Angeles for the last 25 years, with the exception of the period covered by his service in the World War, died in Los Angeles on March. 4.

Edgar L. Wood, Sr., Hecla Mining Company construction superintendent since 1919, died at Wallace, Idaho, on March 3 at the age of 54.

Dr. Frederick C. Langenberg, a widely known metallurgist and formerly a teacher of metallurgy in Harvard, died at Edgewater Park, N. J. on April 4, at the age of 47.

Dr. Charles Henry Smyth, Jr., emeritus professor of geology at Princeton University and a member of the faculty of Princeton for 29 years, died at Princeton, N. J., on April 4 at the age of 71.

Edmund E. Campbell, president of Mining Research Corporation, died in Toronto on Feb. 1. He was a graduate of McGill University, and from 1910 to 1920 was a member of the staff of the Granby Consolidated Mining, Smelting & Power Company, in British Columbia.

William V. Somerville died suddenly in Vancouver, B. C., on Feb. 13 at the age of 74. He was a pioneer mine operator in the Yukon, and at the time of death was president of several British Columbia companies.

E. A. Campbell, president of Mining Research Corporation and well known in Canadian mining circles, died recently at the age of 56.

Ezra A. Thompson, chief of the chemical division of the Mines Branch, Department of Mines and Resources, Ottawa, Canada, died on Feb. 5 at the age of 58. He was a graduate of Queen's University, and for some time was on the teaching staff of the University of Manitoba. He joined the Dominion Department of Mines in 1916.

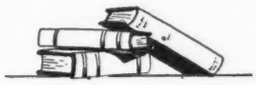
W. R. Wilson, long associated with the mining industries of Canada, and who was largely interested in the Premier Gold Mining Company, died on March 24 at the age of 80. He was a past president of the Canadian Institute of Mining and Metallurgy.

Fred Cushing Moore, consulting mining engineer, widely known in Spokane, Wash., and throughout Northwestern mining circles, died in that city on March 23 at the age of 61. He was president of the Northwestern Mining Association, the Associated Engineers of Spokane, and the Columbia Section of the A.I.M.E.

Bernard MacDonald, mining engineer and consultant in gold and silver mining, long identified with enterprises in British Columbia, Mexico, and the West, and who had for many years been prominent in the civic affairs of his community, died at Oceanside, Calif., on March 29 at the age of 82.

Henry Key Sewell Klingender, 79, for many years a figure active in Western mining and a second cousin of Francis Scott Key, author of the "Star Spangled Banner," died on Feb. 25 at his Salt Lake home. Mr. Klingender was born and educated in England, and started his mining career in Colorado and later held positions with mining companies in Utah, Nevada, Colorado, New Mexico and Alaska.

NEW BOOKS



THE THEORY OF GOLD SUPPLY. *By W. J. Busschau. Oxford University Press, 114 Fifth Ave., New York. Pp. 193. Price $3.75.*

THIS is the first of a series of "Oxford Studies in Economics," under the general editorship of D. H. MacGregor, G. D. H. Cole, and J. Marschak, with a foreword by D. H. MacGregor. In a brief introduction the author eliminates the question of choice of monetary policy and limits the field of discussion to three questions—

A. What factors determine the rate of gold output in tons of ore.

B. What factors determine grade, since tonnage multiplied by grade per ton will give output in ounces of gold.

C. How does government intervention in the form of taxation, etc., influence grade and scale of operations.

Partly because of his especial knowledge of the conditions under which gold mining operates on the Witwatersrand and partly because of essential data not available for other districts, he has applied these questions primarily to the South African industry. This in no way lessens the value of the contribution to other gold-mining fields in the world. He calls particular attention to the relation of governmental policy to the industry because of its vital importance in the case of the Union of South Africa. These chapters deal with the following topics: The valuation of mining property; the speculative rate. The valuation of mining property; the income. The rate of gold supply. The determination of the grades of ore worked. The influence of taxation on grade; and gold-mining profits and South African income taxation.

He has treated the subject quantitatively so far as possible; in most cases developed the algebraic formulas to express these quantitative relations.

To summarize the author's own concept of his objective, we quote the closing paragraph of his introduction:

"The masters of economics, in their published work, appear to have paid scant attention to the significance in the economy of minerals generally, and even in bulky textbooks little is found on the subject. On the other hand, technical mining publications are usually written by people with scant knowledge of economic reasoning. This renders the present task doubly difficult. It is necessary, therefore, to consider first the speculative rate at which mining investment takes place, and then to proceed to a discussion of mining income. After the factors governing gold supply have been considered under simple assumptions, the complications of taxation will be superimposed on the previous analysis, and, lastly, an attempt will be made to consider some aspects of the relation of the State to gold-mining. Further than this it is not intended to go, but it is hoped that the results obtained will go some way in assisting to clarify the issues, which, in popular discussions, often with a complete neglect of the technical factors, have tended to become somewhat confused."

Those who are unfamiliar with operations on the Rand will find much of interest in Dr. Busschau's description of the dual relationship of the industry to the Government of South Africa, first as to major source of tax revenue, and, second, as the active partner in profits of the industry. There is much to be learned by industry and governments in other parts of the world from the successes and failures recorded in the history of the Rand in the development of these relations. In the judgment of the author, the present system of taxation, already modified twice since the Union left the gold standard at the end of 1932, over a year after sterling had been divorced from gold, leaves much to be desired from the standpoint of sound economics. He stresses the following weaknesses—

First, that the tax formulas encourage the mining of unprofitable material, his test being that the industry should be regulated to create the greatest present value for its owners, which in the case of all the leased mines include the government as a sharer in the profits. In the future development of the outlying areas, the proportion of leases to outright ownership will grow very rapidly.

Second, he illustrates with quantitative examples the inequities of present taxation as between mine and mine and suggests how these might be eliminated.

Third, he clearly demonstrates the inequities as between gold mining, diamond mining, and other forms of activity under the income tax.

He summarizes his reasons for contesting the claim for an especially high rate of taxation for gold mining as follows:

"While the gold and other minerals discovered in South Africa were too, as it were, 'manna' from heaven, there is no reason to believe that divine providence guarantees that supplies of minerals will, through fresh discovery and development, last forever, keep pace with increases in population, ensure a constantly progressive economy, or ensure that a particular area will be in constant possession of a standard of life in a fixed relation to that of other areas. To the mining country, or area, the issue is simply that of replacing capital in other directions so as to keep it constant for that reason. It is not an argument for a higher rate of taxation on mining income alone, since if it were and it is carried to its logical conclusion, the Government should take enough to provide for the amortization of all the capital in gold-mining, and then there would not be enough to give an amortization amount and income to the investor.

"The practical position, then, is that it is largely an argument of expediency, and it can be accepted at all, only if those urging it can produce enough evidence to prove the existence of certain facts on which the thesis depends. They must prove:

"1. That capital is by reason of outside investment of amortization funds actually diminishing, or that shareholders provide in internal investment no, or insufficient, amortization;

"2. That the proceeds of the taxation are actually spent on capital and not as income; and

"3. That the losses of ores in areas pushed out of production are not too great to outbalance the net gains of the policy in other directions."

By eliminating the question of the peculiar position of gold as the monetary metal, his reasoning has almost equal weight with respect to any other mineral product, and will, therefore, prove of universal interest to those concerned with the exploitation or appraisal of mining investments.

ARTHUR NOTMAN

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ROBERT HALLOWELL RICHARDS—HIS MARK. *An Autobiography. Little, Brown & Company, Boston. Pp. 329. Price $3.*

ONE does not have to be a former student of Professor Richards to feel a real delight in this tale of the life of a distinguished man, who will be 93 years old next Aug. 26. Charming simplicity marks the narrative throughout. Born in his grandfather's home, Oaklands, at Gardiner, Me., which town, like the adjoining Hallowell, was named for a member of his family, and having received part of his elementary education abroad, he entered the newly established Massachusetts Institute of Technology in 1865, being the seventh student to enroll. Upon graduation he was asked to stay as an instructor, and there he taught until his retirement in 1914 on reaching the biblical threescore and ten. "My personal struggle is so much wrapped up in Tech," he writes, "that this account becomes inevitably a history of the development of Tech. I am not sorry for this. Indeed it is my greatest justification for writing of myself. Because I have been privileged to take part in the beginnings and development of what has now become an important institution in America, I feel that the story warrants writing."

The splendid institution, he says, had a humble beginning, a real struggle for existence. His own labors started with teaching elementary chemistry in the fall of 1868. His account of this first effort is whimsical. Soon he was instructing in the laboratory, and when the first summer school for visiting mines and smelters was started in 1871, he was a member. At its conclusion, he was put

in charge of developing the mining and metallurgical laboratories of the school. In this pioneer work and its fruitful results he achieved a great success. Out of it came eventually his monumental treatise on "Ore Dressing," the grandfather of all such modern treatises, which has graced the libraries of so many engineers and plants.

He pays just tribute to Mrs. Richards, also a pioneer, having been the first woman ever admitted to Technology, whom he married upon her graduation and who as an instructor of women in chemistry and other capacities was identified with the school until her death in 1911.

Keen observer, both in the laboratory and out-of-doors, ingenious inventor, lover of nature, and philosopher, for so he shows himself in these pages, Professor Richards' story of his life is replete with interest, humor, wisdom, and kindly reminiscence. Pre-eminently he was a teacher. A. H. HUBBELL

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MINE PLANT DESIGN. *By W. W. Staley. McGraw-Hill Book Company, New York. Pp. 386. Price $5.*

HOW MUCH of the engineering fundamentals required for designing a mine plant the average mining engineer can command some years after he has left his schooling behind him it would be hard to say. A great deal will depend on the man and the character of his experience. This may have been such as to make little demand upon his earlier knowledge of fundamentals, in which case he may be rather rusty, if not worse. But so varied are the tasks that may fall to the lot of any engineer that after years of disuse some part of this special detailed knowledge may be urgently required. Then must the "mining man" busy himself with pencil, drawing board, and tables, and the question of how to go about the job may involve much searching and review.

For such embarrassing moments, Mr. Staley's book on mine plant design will be a godsend. He himself takes his pencil and board in hand and sets about the task, explaining each step as he proceeds. He presents his calculations, which is a great help. His book by no means obviates all need of searching and review, but it will save the day in many a case. More space could have been given in the book to some of the topics treated. Used cautiously and with common sense, however, it should be worth the trouble of obtaining it. Likewise for current use, students should find it helpful.

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CANADIAN MINES HANDBOOK, 1937. *Northern Miner Press, Ltd., 122 Richmond St. West, Toronto, Ont. Pp. 383. Price $1.*

COMPANIES listed in the new edition of this useful volume total 4,714, as compared with 3,744 in the 1936 book and 2,724 in 1935. Of these, 1,281 were active at the end of 1936, 592 of them new and 89 old ones that had been revived. The book is divided into two parts, the first giving the principal companies and the second the remaining companies, including the inactive ones. All who are interested in mining in the Dominion will find this book convenient.

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STRUCTURAL GEOLOGY, With Special Reference to Economic Deposits. *By Bohuslav Stoces and Charles Henry White. D. Van Nostrand Company, Inc., 250 Fourth Ave., New York. Pp. 460. Price $9.*

THIS VOLUME, avowedly a textbook, fulfills its purpose admirably in the detailed presentation of the subject in the text and in the profuse illustration that really illustrates. No fewer than 663 photographs and sketches are reproduced. Clarity of explanation to insure that the student-reader really understands has undoubtedly been the aim of each author. Evidently they hold that the function of a teacher is primarily to teach, and of a textbook to serve as the teacher himself in his absence and not merely as a demonstration of the teacher's knowledge. The volume, it should be said, is an elaboration by Dr. White of the work, well known abroad, of Dr. Stoces, of the Bergacademie at Pribram, Czechoslovakia, previously published in both Czech and German. The earlier text, Dr. White states, has been rearranged and enlarged and the number of illustrations nearly doubled.

Primary structures and arrangement of sedimentary rocks are dealt with up to page 109. Discussion then follows of induced or secondary structures due to orogenic movements, the successive topics being folding, faulting, joints, veins, conformities and unconformities, and principal types of structures. Chapters on surveying of geologic structures, geophysical methods, geological maps, and, last, the influence of structure on mining practice complete the book—that is, save for a glossary and a bibliography.

In the allotment of space to these topics, the treatment is possibly somewhat poorly balanced. The subjects of a large part of the illustrations are taken from outside of the United States, as might be expected. The book is unquestionably valuable, but the price quoted will hardly insure for it a wide distribution.

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TECHNOLOGY OF ALUMINUM AND ITS LIGHT ALLOYS. *By Alfred von Zeerleder. Translated into English from the second German edition by A. J. Field. Gutav Fock, New York, 1936. Pp. 300. Illustrations, 219. Price, $5.50.*

ON THE AUTHOR'S PART, this book represents an effort to put the essential knowledge of the possibilities of aluminum in a practical way before the widest circle of readers. The production of the metal and the theory of alloys are dealt with, it is said, only so that correct manufacturing methods may be understood. Note is taken of American, British, Swiss, and German practice. The translator has furthered the author's effort by giving careful attention to the terminology used, so that both British and American readers will experience minimum difficulty with the text. It is not possible always to please both completely. To avoid the appearance of partiality and doubtless of commercial predilections as well, the author has classified the alloys discussed in nine types and deals with them by type number.

After disposing of the matters of production of the metal and alloy theory, the book takes up the commercial alloys themselves, listing 206 named alloys, most of which are European, and 58 numbered alloys, all of them American. Discussion of properties of technical importance and the methods of testing them follows. Next come chapters on furnaces and furnace operations and on casting technique respectively. Fabrication is next dealt with, eight chapters discussing as many individual operations, such as sheet rolling, extrusion and drawing of tubes and sections, forging, press work and spinning, wire production, welding and soldering, riveting, and machining. A short chapter on aluminum powder manufacture follows, wherein the author speaks of the use of the powder for pigments and paints, lithographic purposes, fireworks, and explosives, but fails to mention the growing field of so-called "powder metallurgy." Then follows discussion of surface treatment, and certain general considerations of design, forming, assembly and corrosion-protection, with chapters also on applications and specifications. The book concludes with a painstaking bibliography.

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MINING YEARBOOK 1937. *Published by Walter E. Skinner, 15 Dowgate Hill, Cannon St., London, E.C.4. Pp. 1040. Price 20s. net; 21s. 6d. post free abroad.*

THIS is the 51st annual issue of the standard international reference-work on mines of the world. The current volume lists and describes the operations of 1,323 of the world's principal mining companies, including 315 new concerns which have been added in the last two years. A useful feature is the numerous maps of properties belonging to the various companies. The publisher has made every effort to maintain the reputation of the book for completeness and accuracy.

PUBLICATIONS

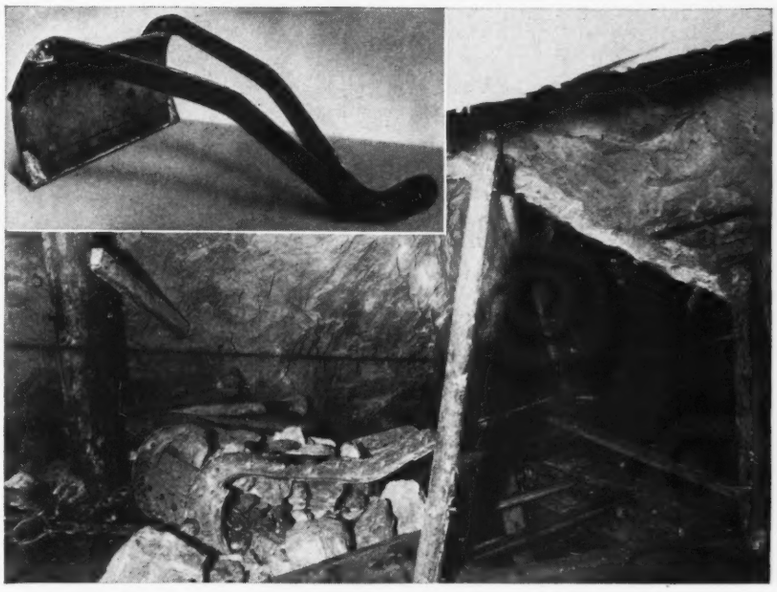
RECEIVED

✦ *Alignment Charts—Their Construction and Use.* By P. N. Lehoczky. Circular 34. Ohio State University, Engineering Experiment Station, Columbus, Ohio. Pp. 62.

✦ *Nova Scotia—Annual Report of Mines, 1936.* Department of Public Works and Mines. Halifax, N. S. Pp. 293.

✦ *Idaho, Mining Industry of.* By Arthur Campbell. 1936 annual report of State Inspector of Mines, Boise, Idaho. Pp. 315.

EQUIPMENT NEWS



NEW SCRAPERS used in this Canadian gold mine are always hard-faced with a chromium-manganese-iron alloy by the electric arc welding process before they are put into service, and whenever the scrapers become worn they are rebuilt with this alloy. Because of this treatment, their service life is said to be greatly extended, since the wear-resistant self-hardening alloy is applied to every wearing edge and surface, lips, back edges, and all the other parts of the frame which may wear rapidly. The alloy is self-hardening and is known as Hascrome.

New Galvanized Sheet

FULL commercial production of a new kind of galvanized sheet that assures a good paint bond on iron and steel products has been announced by the American Rolling Mill Company, of Middletown, Ohio. Introduction of "Armco Galvanized Paintgrip" sheets follows several years of intensive research on the part of Armco's metallurgists and the technicians of the Parker Rust-Proof Company. This new kind of galvanized sheet metal can be painted without special treatment of the surface by the user.

Armco Paintgrip sheets, the manufacturers say, are chemically treated to produce a finely crystalline phosphate coating which in itself is neutral to paint (being neither acid nor alkaline) and keeps the paint from direct contact with the zinc surface. This coating is an integral part of the sheet and is slightly granular in nature.

Forming qualities of Armco Paintgrip sheets are the same as those of untreated galvanized sheets. They may be soldered satisfactorily with the use of hydrochloric acid as a flux. So-called "cut-acid" is not strong enough to penetrate the Paintgrip film, which must be dissolved before a good solder bond can be obtained. Though Paintgrip sheets shipped from the company's mills are prepared to receive paint without further treatment, handling and fabricating operations in customers' plants will often necessitate cleaning. Organic cleaners such as naphtha, benzine, and lacquer thinners are preferred. If alkaline cleaners are used, the surface will be attacked and partly removed by their action. Because of its crystalline, absorbent nature, the surface of a sheet will tend to absorb a certain amount of the alkalies, which are difficult to remove. Alkaline conditions under a coat of paint are considered one of the most common causes of early paint failure.

Practically any good paint can be applied to these sheets. If baked finishes are used, the paint manufacturer usually recommends a suitable primer. Any good baking system will be found satisfactory for the sheets, provided the baking temperature does not exceed 450 deg. F. Higher temperatures are likely to be detrimental, particularly if the time of baking exceeds fifteen minutes. Formation of a Paintgrip coating on metal is dependent upon the fact that phosphoric acid solutions will dissolve zinc phosphate within certain definite limits. Passing zinc-coated iron or steel products through such a solution results in the formation of the Paintgrip coating, which becomes an integral part of the metal surface at the point of solution. Reaction takes place with the evolution of hydrogen, continuing until the metal surface is completely converted to a crystalline phosphate coating.

New Insulating Brick

THE Johns-Manville Corporation, of 22 East 40th St., New York City, has recently placed on the market a new type of 2,000-deg. insulating brick known as "JM-20." This new brick was developed by the company's research laboratories and is said to be for use behind refractory walls in various types of high-temperature industrial equipment, including boiler settings, ceramic kilns, steel plant equipment, and practically all types of furnaces. It can also be used for direct exposure at temperatures up to 2,000 deg. F. wherever there is no flame impingement, slag action, or mechanical abrasion. This new type of insulating refractory is produced by combining a high-quality refractory clay with a specially manufactured vibrous, light-weight, inorganic aggregate.

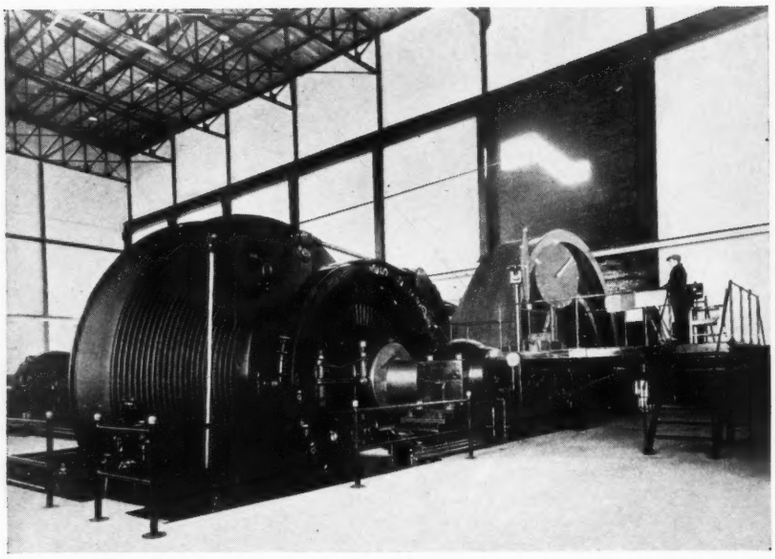
The brick is said to be unusually light, weighing less than 1.7 lb. per standard 9-in. equivalent. Its heat capacity is said to be less than one-quarter that of ordinary refractories, and its thermal conductivity is less than one-sixth that of firebrick.

Midget Contactors

MIDGET CONTACTORS and line starters comprise a line of remote-controlled, reversing and non-reversing magnetic starters for small, single-phase and polyphase squirrel-cage induction motors, announced by Westinghouse, East Pittsburgh, Pa. The non-reversing contactors are said to be particularly adapted for use with motors driving air-conditioning equipment, small compressors, small pumps, oil burners, domestic stokers, small fans, and small machine tools.

These contactors and line starters will fit in unusually small spaces. Coin silver contacts provide long life and maximum conductivity. The operating mechanism is mounted on an insulating base and may be removed as a unit from the cabinet. Minute control current permits operation from two- and three-wire thermostats, pyrometers, pressure gages, and other delicate instruments as well as from small pushbuttons and float switches. The contactors are available for 1/2 hp., 110 volts, or 1 hp., 220 volts, single pole or two pole, single phase for use either as a remote-controlled line switch or as a motor starter.

These contactors are supplied with operating coils wound as standard for 110 and 220 volts, 60, 50, and 25 cycles, although coils are said to be wound for any desired voltage up to 220 volts. Contractors can also be supplied with a



THE LARGEST ELECTRIC HOIST in Canada was placed in operation this year at the Creighton mine of the International Nickel Company in Canada. From drawings made by Allis-Chalmers Manufacturing Company of Milwaukee, it was built by Canadian Allis-Chalmers, Ltd. It is designed to raise a net ore load of 18,000 lb. per trip in skips weighing 10,000 lb. each in a vertical shaft. Other features of this hoist are mentioned in the June and September, 1936, and February, 1937, issues of *Engineering and Mining Journal*.

dual-voltage operating coil for operation from a pushbutton. By connecting to the proper terminals, the starter is adapted to operation either on 110 or 220 volts.

Thermal Overload Switch

A NEW thermal overload switch for fractional-horsepower motors, operating on line current and arranged for convenient mounting on the conduit or terminal box of the motor, has recently been placed on the market by the General Electric Company, Schenectady, N. Y. It is said to be completely self-contained and has no links or plugs to be replaced.

Known as the "thermo-tector," the device automatically disconnects the motor from the line, when an overload occurs, before the motor reaches a dangerous temperature. Then, when the motor has cooled, it is automatically reconnected to the line, the entire operation being repeated at a safe interval until the motor is freed of overload or is removed from the line. Where the automatic-reset feature is not required, a form of the new switch is available which can be used to disconnect the motor from the line and leave it disconnected until the device is manually reset.

The Thermo-Tector is available in ratings for a.c. fractional-horsepower motors having rated full-load currents of from 1.3 to 10.4 amp.

Circuit Breakers

EQUIPMENT and circuit protection in hazardous locations where inflammable gases and explosive dusts prevail is provided by a special housing developed for its line of circuit breakers called Re-Cirk-It breakers by the Heinemann Electric Company, Trenton, N. J. A two-part metal casting houses the circuit breaker in place of the usual pressed-steel cabinet. The circuit breaker is mounted on the upper section and is actuated by an approved bushed handle which closes and opens the circuit independently of the tripping action of the inclosed breaker, when normal conditions prevail. It is said to be very accessible for wiring. Tapped hubs for 1-in. threaded conduit are provided at the top of the casing. The bottom section slips around the breaker and screws into the upper casting, sealing the mechanism.

Circuit breakers to be mounted in this special casing are available in any capacity from 50 milliamperes up to 35 amperes, and 1, 2, and 3 poles. Also, there is a choice of instantaneous trip and time-delay types, the latter said to be available in any one of four different time lags, to meet different circuit characteristics.

Mounted Capacitor

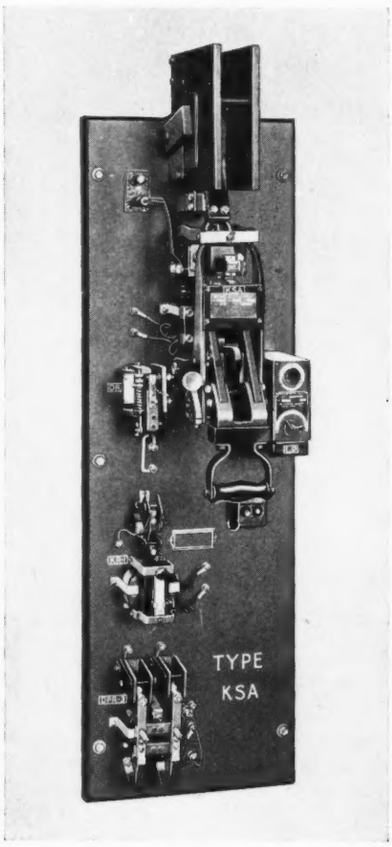
A NEW TYPE of weather-proof, steel-clad, hermetically sealed 15-kva. capacitor unit suitable for pole mounting on distribution circuits is announced by Westinghouse Electric & Manufacturing Company, East Pittsburgh, Pa. These units contain an internal discharge device and are provided with means of mounting on brackets to crossarms or direct to poles, or in groups of four on single angle-iron racks, making possible inexpensive installations up to 180 kva. on one pair of crossarms.

The increasing use of air-conditioning and refrigeration and other motor-operated devices is emphasizing the need for eliminating reactive current from distribution circuits, particularly circuits of the 4-kva. class. Reactive current in these circuits causes a voltage drop much in excess of the drop resulting from the power current. The use of these new shunt capacitors on distribution circuits will greatly increase the power handling capacity and the over-all efficiency of distribution. Standard distribution transformer tests are said to have been adopted for these new capacitor units and bushing characteristics have been made to conform to current practice with transformers. The units are of the Inerteen type, with completely welded construction, and soldered to porcelain type terminals. Provision is made in the terminal design on the higher voltage ratings to eliminate radio interference.

These new capacitors may be connected with the standard form of lightning-arrester protection and with fuse cut-outs. The fuse cut-outs may be used to connect and disconnect the capacitor banks from the line.

Automatic Reclosing Circuit Breakers

THE I-T-E CIRCUIT BREAKER COMPANY, of 1505 Race St., Philadelphia, announces its Type KSA circuit breaker for the control of semi-automatic and full automatic motor-generator rotary-converter and mercury-arc rectifier substations. This type of breaker is primarily magnetically operated, consisting of the following elements: 1, a circuit-breaker element comprising a magnetically operated circuit breaker for opening, maintaining, and closing a load circuit; 2, an auxiliary control element comprising a number of auxiliary relays for governing the performance of the circuit-breaker element and for providing certain predetermined operating characteristics.



The manufacturer states this type of circuit breaker is applicable in the mining industry, as frement overload peaks and faults arise on feeder lines and greater accuracy is obtained by this type of automatic reclosing circuit breaker instead of restoring service through manual operation with no means of knowing exact line conditions.

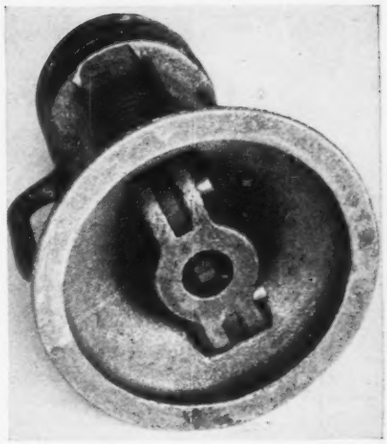
Type KSA circuit breaker is a one-pole switch 750 volts and under 400 to 6,000 amp. Panels as shown are ebony asbestos for mining service with room allowed for accessories. The Type KSC is one-pole 750 volts and under 400 to 2,000 amp. This type of unit is weatherproof, and is suitable for year-around outside pole mounting.

New Lycoming Plant

THE Lycoming Manufacturing Company, of Williamsport, Pa., recently announced a new gas motor generating unit engineered for 100,000 hours of continuous duty, which is said to lower power costs. Under Lycoming's plan the mine operator owns his own electric light and power plant and pays for it, plus operation costs, out of the savings on his present electric bill. The perfecting by Lycoming of a natural-gas motor said to maintain high efficiency and low operating costs, together with an entirely automatic generating unit, is said to have made savings in the cost of electrical energy for those who pay $50 or more per month for their light or power or both.

The plant, automatic in operation, is said to require little attention and is easy to install, merely requiring the connection of a gas pipe to the motor. Sizes range from 10 kw. to 60 kw., generating either alternate or direct current. For the smaller user of electric energy a single motor unit is available. For businesses that require 24-hr. continuous service a Dual-motor unit, composed of two motors and one generator, is offered. Either motor on this latter unit can be operated singly or both together, one motor automatically cutting off when the additional driving power to carry the electrical load is not needed. The gas motor is said to be quiet, clean, and vibrationless, producing no smoke or odor, and to run cool. The company makes it clear that it is engineered to use natural or manufactured gas only and is in no way an adaption of a gasoline engine to use gas.

In the gas motor generating unit the motor, generator, and base are built together into one unit with dampening material incorporated into the base that absorbs any possible vibration. When used as a stationary motor to replace electric motors of from 10 to 50 hp. it is said to operate at only a fraction of the cost of an electric motor.



THE COMBINATION Roemer jack and steel puller for pulling stuck steel or drift pins. If steel projects 1½ in. from surface the teeth engage the steel as the screw-jack is turned. Size of hole is 1¾ in. The jack is 13 in. high, will lift 25 tons, weighs 50 lb., and is manufactured by the Longview Pattern Works, Longview, Wash.

BULLETINS

Welding. Harnischfeger Corp., Milwaukee, Wis. Bulletin No. W-8, describing features of Welders, Pp.3. Bulletin D-6 describes the P-H all-welded dippers. Pp. 4.

Combustion Data. Hauck Manufacturing Co., 124-136 Tenth St., Brooklyn, N. Y. The book has four parts and includes definitions, data on oil burning, data on gas burning, and general combustion data. Pp. 60. Price $1.

Furnace Construction. George P. Reintjes Co., Kansas City, Mo. Bulletin 101 contains diagrams and photographs of the manufacturer's five tile shapes for various furnaces. Pp. 10.

Disk Crusher. Hadfields, Ltd., East Hecla & Hecla Works, Sheffield, England. Bulletin 295 describes the Hecla disk crusher of various sizes for gravel and ores. Pp. 11.

Coupled Pumps. Ingersoll-Rand Co., Phillipsburg, N. J. Bulletin 7066 covers the Cameron coupled pumps, of capacities from 150 to 5,000 r.p.m. against heads between 20 and 250 ft. Pp. 15.

Oil Seal. Garlock Packing Co., Palmyra, N. Y. A booklet containing sizes of "Klozure" sealing rings for retaining oil and grease within a bearing, and diagrams showing various industrial applications. Pp. 40.

Rotary Louvre Dryer. Link-Belt Co., 307 N. Michigan Ave., Chicago, Ill. Folder 1511 describes the Dunfold & Elliott rotary louvre dryer, the manufacture and sales right of which in North America is now held by Link-Belt. Pp. 4.

Diamond Drill. Ingersoll-Rand Co., Phillipsburg, N. J. Bulletin No. 2231 describes the "Coroc" diamond drill. Pp. 4.

Air Conditioning. Carrier Corporation, 850 Frelinghuysen Ave., Newark, N. J. Bulletin CE 100 describes and illustrates air-conditioning equipment for industry, business, and the home. Pp. 15.

Rolling Doors. Cornell Iron Works, 3600 13th St., Long Island City, N. Y. A booklet describing various sizes and uses of rolling steel doors. Pp. 8.

Thermometer and Pressure Gages. Brown Instrument Co., Philadelphia, Pa. Catalog 6703 gives a description of instruments which indicate, record, and control temperatures and pressures. Pp. 72.

Connector. Anconda Wire & Cable Co., 25 Broadway, New York City. Anaconda Publication G8, featuring economical ways of making splices with rolled and seamless connectors. Pp. 10.

Gold Extraction. Imperial Chemical Industries, Ltd. Millbank, London, S.W.1. England. A small paper-bound booklet with notes on cyanidation for the small operator. Pp. 62.

Diesel Engines. Copper-Bessemer Corp., Mount Vernon, Ohio. Bulletin describing advanced features of Type EN diesels with 3-4-6-8 cylinders. Pp. 7.

Speed Recorder. Leeds & Northrup Co., 4901 Stenton Ave., Philadelphia, Pa. Folder N 27, describing potentiometer recorder. Pp. 4.

Wire and Cables. Anaconda Wire & Cable Co., 25 Broadway, New York City. A handbook of wire and cable for all occupancies and types of conditions. Pp. 14.

Sprocket Wheels. Link-Belt Co., 519 North Holmes Ave., Indianapolis, Ind. Book No. 1557 has tabulation of many cut-tooth sprocket wheels. Pp. 24.

Air-Operated Controller. Brown Instrument Co., Wayne and Roberts Ave., Philadelphia, Pa. Catalog 8901 describing features of air-operated controllers for temperature, pressure flow, and liquid level. Pp. 6.

Gas Engines. Worthington Pump & Machinery Corp., Harrison, N. J. Bulletin S-550-B4B illustrates and describes Type AG vertical small heavy-duty engine. Pp. 7.

Shovel Power Controls. Link Belt Company, 307 North Michigan Ave., Chicago, Ill. Folder 1569 describes Speed-O-Matic dragline and crane controls. Pp. 4.

General Data Book of steel products manufactured by J. T. Ryerson & Sons, Lock Box O, Chicago, Ill. A handy pocket reference book of shop data on tool and alloy steels; also numerous reference tables. Pp. 192.

Hand-Rotated Stoper. Worthington Pump & Machinery Corp., Harrison, N. J. Bulletins 1200-B17, listing specifications of dry and wet Model WS-3 stoper. Pp. 4.

Thermocouple Pyrometers. Leeds & Northrup Co., 4902 Stenton Ave., Philadelphia, Pa. Catalog N-33A is well illustrated and explains the potentiometer method of measurement in Micromax instruments. Pp. 52.

INDUSTRIAL NOTES

J. A. Krugler, of New York, has been appointed general sales manager of the Taylor-Wharton Iron & Steel Company, High Bridge, N. J. Mr. Krugler succeeds J. C. Taylor, Jr., who recently resigned.

The Manhattan Rubber Manufacturing Division of Raybestos-Manhattan, Inc., Passaic, N. J., is opening a new West Coast branch office and warehouse at 778 Brannan St., San Francisco, Calif.

The American Chain Company, Inc., has changed the corporate name to American Chain & Cable Company, Inc. The general executive offices will remain at Bridgeport, Conn., and 230 Park Ave., New York City. District sales offices are located at Boston, New York, Philadelphia, Detroit, Chicago, San Francisco, Pittsburgh, Atlanta, Tulsa, Houston, Denver, Los Angeles, and Fort Worth.

General Engineering Company has opened a laboratory and office at 823 East Van Buren st., Phoenix, Ariz., under the charge of Harmon E. Keyes, chemist and metallurgical engineer.

Cutler-Hammer, Inc., manufacturers of electric-control apparatus, at Milwaukee, Wis., announces the appointment of T. D. Montgomery as manager of its foreign sales division.

Atlas Publishing Company, 152 Lafayette St., New York City, has acquired the copyright and name of the Mines Handbook and its predecessor the Copper Handbook. The publishers announce their intention to publish about mid-year a new mining directory to be known as the Mines Register.

The Worthington Company, Inc., with offices in Seattle, San Francisco, Los Angeles, and El Paso, effective Jan. 1, was absorbed by its parent organization, Worthington Pump & Machinery Corporation, of Harrison, N. J.

Summary of the

MARKETS

THE boom conditions that have characterized trading in non-ferrous metals since last November continued throughout March, again largely under the leadership of London. Prices for the major metals made new highs during the month, with interest centering in the advance in copper in the domestic trade to the basis of 17c. per pound. The upward trend in commodity prices was quite general, embracing cotton, rubber, grains, iron, steel, alloys, tungsten ore, and chrome ore. Manganese prices were almost wholly nominal.

After establishing new highs for the movement, the London market developed quite some irregularity on realizing by speculators and increased offerings of metals for forward delivery. On March 11 electrolytic copper in London actually touched £80 per ton, bid. Buying of metals slackened toward the end of the period.

Consumption of copper, lead, and zinc in the United States during March was greater in volume than in the preceding month, even though labor difficulties were a disturbing factor, particularly in the automobile industry. The *E. & M. J.* index of non-ferrous metal prices for March was 103.78, against 91.68 in February, and 71.90 in March last year. The index is now at the highest point reached since December, 1929.

Just as the London market for copper showed signs of price unsettlement, domestic producers raised the quotation here to the basis of 17c. per pound, a gain of three-quarters of a cent. Producers attributed the advance to the favorable outlook on consumption of copper and the shortage in supplies.

Lead advanced to 7¾c., New York, but on first signs of weakness abroad producers quickly lowered the price to what, in their opinion, was a more reasonable level. Prime Western zinc, on scarcity in supplies, advanced to 7½c., St. Louis.

UNITED STATES MARKET

1937 Mar.	Electrolytic Copper Domestic (a)	Electrolytic Copper Export (b)	Straits Tin New York	Lead New York	Lead St. Louis	Zinc St. Louis
1	14.775	15.625	54.000	7.00	6.85	6.80
2	14.775	15.750	55.150	7.00	6.85	7.00
3	14.775	16.000	57.000	7.00	6.85	7.00
4	14.775	16.050	57.250	7.00	6.85	7.00
5	14.775	16.100	58.000	7.00	6.85	7.00
6	14.775	16.000	59.000	7.00	6.85	7.00
8	16.025	16.250	60.000	7.25	7.10	7.50
9	16.025	16.500	63.000	7.50	7.35	7.50
10	16.025	16.650	66.000	7.75	7.60	7.50
11	16.025	17.100	64.625	7.75	7.60	7.50
12	16.025	16.850	66.250	7.75	7.60	7.50
13	16.025	17.025	66.750	7.75	7.60	7.50
15	16.025	17.150	66.750	7.75	7.60	7.50
16	16.025	16.850	65.000	7.50	7.35	7.50
17	16.025	16.750	65.500	7.25	7.10	7.50
18	16.025	16.850	66.000	7.25	7.10	7.50
19	16.025	16.800	64.125	7.00	6.85	7.50
20	16.025	16.600	63.750	7.00	6.85	7.50
22	16.025	16.475	62.000	7.00	6.85	7.50
23	16.025	16.325	64.000	6.975	6.825	7.50
24	16.025	16.450	65.375	6.95	6.80	7.50
25	16.025	16.975	66.000	6.95	6.80	7.50
26	16.025	16.950	66.000	6.95	6.80	7.50
27	16.025	16.950	66.000	6.95	6.80	7.50
29	16.025	16.950	65.875	6.95	6.80	7.50
30	16.025	17.000	63.750	6.95	6.80	7.50
31	16.775	16.950	65.000	6.95	6.80	7.50
Av. for month	15.775	16.590	63.043	7.190	7.040	7.381
AVERAGES FOR THE WEEK						
Mar.						
3	14.775	15.813	55.108	7.000	6.850	6.867
10	15.400	16.258	60.542	7.250	7.100	7.250
17	16.025	16.954	65.813	7.625	7.475	7.500
24	16.025	16.583	64.208	7.029	6.879	7.500
31	16.150	16.963	65.438	6.950	6.800	7.500
CALENDAR WEEK AVERAGES						
Mar.						
6	14.775	15.921	56.733	7.000	6.850	6.967
13	16.025	16.729	64.438	7.625	7.475	7.500
20	16.025	16.833	65.188	7.292	7.142	7.500
27	16.025	16.688	64.896	6.963	6.813	7.500

SILVER, GOLD, AND STERLING EXCHANGE

NEW YORK AND LONDON

1937 Mar.	Sterling Exchange "Checks"	Sterling Exchange "90-day demand"	Silver (c) New York	Silver (c) London	Gold London	Gold (d) United States
1	4.88750	4.88000	44.750	20.1875	142s 3½d	$35.00
2	4.89000	4.88250	44.750	20.2500	142s 2½d	35.00
3	4.88750	4.87875	44.750	20.4375	142s 2½d	35.00
4	4.88500	4.87625	45.250	21.1250	142s 4 d	35.00
5	4.88000	4.87125	45.000	20.8125	142s 6½d	35.00
6	4.87875	4.87000	(e)	20.8750	142s 7½d	35.00
8	4.87875	4.87000	45.000	20.8125	142s 7 d	35.00
9	4.88125	4.87250	44.750	20.4375	142s 6½d	35.00
10	4.88375	4.87625	44.875	20.4375	142s 2½d	35.00
11	4.88375	4.87625	45.000	20.5000	142s 4½d	35.00
12	4.88125	4.87250	45.250	20.6875	142s 5½d	35.00
13	4.88375	4.87500	(e)	20.6875	142s 4½d	35.00
15	4.88375	4.87625	45.375	20.7500	142s 3½d	35.00
16	4.88500	4.87625	45.625	20.8750	142s 4 d	35.00
17	4.88500	4.87625	45.750	20.9375	142s 4 d	35.00
18	4.88625	4.87750	45.625	20.8750	142s 4 d	35.00
19	4.88500	4.87625	45.250	20.7500	142s 4½d	35.00
20	4.88250	4.87625	(e)	20.5625	142s 4½d	35.00
22	4.88125	4.87250	45.250	20.7500	142s 4½d	35.00
23	4.88375	4.87625	45.250	20.6250	142s 4½d	35.00
24	4.88500	4.87750	45.000	20.5625	142s 3½d	35.00
25	4.88375	4.87625	45.000	20.5625	142s 4 d	35.00
26	4.88500	4.87750	45.000	Holiday	Holiday	35.00
27	4.88500	4.87750	(e)	Holiday	Holiday	35.00
29	4.88500	4.87750	45.000	Holiday	Holiday	35.00
30	4.88500	4.87750	45.250	20.8125	142s 3 d	35.00
31	4.88875	4.88125	45.250	20.9375	142s 2½d	35.00
Av. for month	4.88412	.....	45.130	20.677	.....	35.00
AVERAGES FOR THE WEEK						
Mar.						
3	4.88771	.....	44.750	.....	.....	.....
10	4.88125	.....	44.975	.....	.....	.....
17	4.88375	.....	45.400	.....	.....	.....
24	4.88396	.....	45.275	.....	.....	.....
31	4.88542	.....	45.100	.....	.....	.....

Calendar week averages: New York Silver, Mar. 6th, 44.900; 13th, 44.975; 20th, 45.525; 27th, 45.100.

(e) No quotation (Saturday).

THE above quotations for major non-ferrous metals are our appraisal of the important United States markets, based on sales reported by producers and agencies. They are reduced to the basis of cash, New York or St. Louis, as noted. All prices are in cents per pound.

(a) Net prices at refineries on Atlantic seaboard. To arrive at the delivered New England basis, add 0.225c. per pound, the average differential for freight and interest charges.

(b) Export prices are net at refineries on the Atlantic seaboard and include sales of domestic copper in the foreign market. Most sales in the foreign market are made on the basis of c.i.f. usual ports of destination—Hamburg, Havre, and Liverpool. The c.i.f. basis commands a premium of 0.300c. per pound above our refinery quotation.

Copper, lead and zinc quotations are based on sales for both prompt and future deliveries; tin quotations are for prompt delivery only.

Quotations for copper are for the ordinary forms of wirebars and ingot bars; cathodes are sold at a discount of 0.125c.

Quotations for zinc are for ordinary Prime Western brands. Zinc in New York commands a premium over the St. Louis basis equal to the freight differential. Contract prices for High Grade zinc delivered in the East and Middle West in nearly all instances command a premium of 1c. per pound over the current market for Prime Western but not less than 1c. over the *E. & M. J.* average for Prime Western for the previous month.

Quotations for lead reflect prices obtained for common lead, and do not include grades on which a premium is asked.

(c) Silver other than newly mined domestic. Under Executive order issued April 24, 1935, the U. S. Government's price on newly mined domestic silver was established at 77.57. Handy & Harman's quotation for domestic silver, .999 fine, was 77c. per ounce throughout March.

(d) U. S. Treasury's gold price. Actual payment by the United States Treasury for gold in domestic and imported ore or concentrate is at 99.75 per cent of the price quoted by the Treasury, which at present is equal to $34.9125 per ounce.

PRICES OF METALS • MISCELLANEOUS QUOTATIONS

LONDON MARKET

1937 March	Copper Standard Spot	Copper Standard 3M	Copper Electrolytic Bid	Tin Standard Spot	Tin Standard 3M	Lead Spot	Lead 3M	Zinc Spot	Zinc 3M
1	66.2500	66.1250	70.0000	242.5000	243.0000	31.6250	31.6250	29.3750	29.7500
2	68.4375	67.9375	72.5000	244.5000	245.5000	31.6875	31.7500	30.3750	30.7500
3	70.7500	69.1250	73.5000	250.2500	251.5000	32.4375	32.5000	31.0625	31.4375
4	70.3750	69.0000	74.0000	256.2500	257.5000	32.7500	32.8125	31.7500	32.1250
5	69.8750	68.6250	73.5000	256.0000	256.7500	32.8750	32.9375	32.0625	32.4375
8	71.6250	70.7500	75.0000	269.5000	269.2500	34.0625	34.0000	33.6875	34.0000
9	73.0000	71.6250	77.0000	276.5000	275.7500	34.6250	34.5625	35.4375	35.6250
10	77.1250	74.9375	79.0000	301.0000	296.0000	36.0000	35.9375	36.2500	36.2500
11	78.0000	74.7500	80.0000	301.0000	295.0000	36.3750	36.2500	37.0000	37.2500
12	76.2500	72.3750	77.5000	290.0000	282.7500	36.0000	35.9375	34.5625	34.8750
15	77.0000	74.3750	79.0000	311.0000	303.7500	34.6250	34.5000	35.5000	35.6250
16	72.6250	71.6250	77.0000	296.5000	289.5000	33.8125	33.7500	33.7500	33.7500
17	71.5000	70.8750	76.0000	295.7500	288.7500	32.9375	32.9375	33.4375	33.7500
18	74.5000	72.8125	77.5000	300.5000	293.7500	32.9375	32.9375	34.1250	34.3750
19	72.4375	71.5000	77.0000	297.0000	288.5000	31.9375	31.9375	33.1250	33.3125
22	69.5000	68.5000	75.0000	282.0000	277.2500	30.8750	30.8750	30.2500	30.5000
23	68.5000	67.6875	74.0000	285.0000	279.2500	30.6250	30.5000	30.6250	30.7500
24	72.1250	71.6875	78.0000	298.0000	289.2500	31.8750	31.7500	33.6250	33.7500
25	73.3750	72.6875	78.0000	302.0000	293.0000	31.7500	31.5625	33.5625	33.6875
26					Holiday				
29					Holiday				
30	73.0000	72.1250	78.0000	293.5000	288.2500	31.9375	31.8750	33.7500	33.8750
31	72.8750	72.3125	78.0000	294.0000	290.0000	31.8125	31.6250	33.6250	33.6250
Average for month	72.339	.....	76.167	282.988	.....	33.027	32.979	33.188	33.405

CURRENT PRICES—MISCELLANEOUS METALS, ORES, AND NON-METALLIC MINERALS

Quotations cover wholesale lots, prompt shipment, f.o.b. New York, unless otherwise stated

(April 1, 1937)

MISCELLANEOUS METALS

Aluminum, ingot, 99 plus per cent, lb.	20@21c
Antimony, domestic, spot, lb.	16.500c.
Bismuth, ton lots, lb.	$1 00
Cadmium, lb.	90c@$1.20
Chromium, 97 per cent grade, lb.	85c.
Nickel, electrolytic cathodes, lb.	35c.
Magnesium, 99.8 per cent, carloads, lb.	30c.
Palladium, troy oz.	$24.00
Platinum, (official quotation) troy oz.	$58 00
Quicksilver, flask of 76 lb., 100 flasks or more	$91.00@$93.00
Radium, mg. radium content	$40 00
Selenium, 99.5 per cent, lb.	$2 00
Silicon, minimum 97 per cent, spot, lb.	16.50c.
Tellurium, lb.	$1.75@$2 00
Thallium, 100 lb. or more, lb.	$6 50
Titanium, 96 to 98 per cent, lb.	$6.00
Zirconium, commercially pure, lb.	$7 00

METALLIC ORES

Beryllium Ore, f.o.b. mines, ton	$30.00@$35 00
Chrome Ore, 45@47 per cent, c.i.f. Atl. ports, long ton	$20.00@$21.00
Iron Ore, Lake Superior, lower Lake ports, long ton:	
Old Range bessemer	$5.25
Mesabi bessemer	$5.10
Old Range non-bessemer	$5.10
Mesabi, non-bessemer	$4 95
Lead (Galena) 80 per cent Joplin, Mo., ton	$84.40
Manganese Ore, c.i.f. Atlantic ports, long ton unit:	
52@55 per cent	34c.
49@51 per cent	32c.
44@47 per cent	27c.
Molybdenum Ore, 90 per cent, per lb. of contained MoS_2	42c.
Tungsten Ore, per unit of WO_3:	
Chinese duty paid	$21.75
Domestic Scheelite	$21.00
Vanadium Ore, per lb. of contained V_2O_5	27½c.
Zinc Ore, Prime, 60 per cent concentrate, Joplin, Mo.; per ton.	$49.50

METALLIC COMPOUNDS

Arsenious Oxide (arsenic) lb	3c.
Cobalt Oxide, 70@71 per cent, lb.	$1.41@$1.51
Copper Sulphate, 100 lb.	$6 00
Sodium Nitrate, ex vessel, in 200-lb. bags, per 100 lb.	$1 34
Sodium Sulphate, bulk, ton	$13.00@$15.00

ALLOYS

Beryllium-Copper, Master alloy, 2.5 to 3 per cent Be, per lb. of contained Be	$23.00
Ferrochrome, 65@70 per cent chromium, 4@6 per cent carbon, lb.	10½c.
Ferromanganese, 78@82 per cent, gross ton	$95.00
Ferromolybdenum, 50@60 per cent Mo, lb. of Mo contained.	95c.
Ferrosilicon, 50 per cent, gross ton	$69.50
Ferrotungsten, 75@80 per cent, lb. of W contained	$1.40@$1.45

NON-METALLIC MINERALS

Asbestos, f.o.b. mines ton:	
Canadian (Quebec)	
Crude No. 1	$550@$600
Crude No. 2	$200@$225
Spinning fibers	$90@$170
Paper stock	$32.50@$37.50
Shorts	$11@$14.50
Vermont	
Shingle stock	$47.50.....
Paper stock	$35@.....
Cement stock	$23@.....
Barytes, long ton:	
Georgia, crude	$7.00
Missouri, 95 per cent $BaSO_4$, less than 1 per cent iron	$5.50
Bauxite, long ton:	
Domestic, chemical, 55@58 per cent	$6@ $7.50
Domestic, abrasive, 78@84 per cent	$12.50@$15.00
Dalmatian, 50@55 per cent	(a)$5 50@ $7.00
French, 56@59 per cent	(a)$6.50@ 7.50
China Clay, f.o.b. mines, ton:	
South Carolina and Georgia, bulk	$6.50@ $9.00
Delaware, No. 1	$14.00@.....
Feldspar, bulk, ton:	
Potash feldspar, 200 mesh	$17.00
Glass-spar, white, 20 mesh	$11.75
Fluorspar, f.o.b. mines, bulk, Kentucky and Illinois 85-5 per cent, all rail movement, ton	$19.00
Fuller's earth, f.o.b. Georgia or Florida, ton	$7.00@$14.00
Magnesite, per ton:	
Dead-burned, f.o.b. California	$25 00@.....
Dead-burned, f.o.b. Washington	$24.00@.....
Mica, per lb., North Carolina, No. 1 and 2 quality:	
1½ x 2 in	15@30c.
2 x 2 in	30@50c.
3 x 3 in	75@$1.00
3 x 4 in	$1 00@$1.25
4 x 6 in	$2 00@$2.50
White, ground, 70 mesh, ton	$60.00@$80.00
Ocher, Georgia, ton	$19.00@$22.50
Pyrites, Spanish, per long ton unit of S, c.i.f. Atlantic ports	(a)12@12½c.
Silica, water-floated, in bags, 325 mesh, ton	$16 00@$40.00
Sulphur, Texas mines, long ton	$18.00@.....
Talc, f.o.b. works, ton:	
New York, double air-floated, 325 mesh	$12.00@$15.00
New Jersey, mineral pulp	$8.00@$10.00
Vermont, extra white, 200 mesh	$8.50@ $9.00
Tripoli, Missouri, ton:	
40 mesh, cream colored	$15.00@.....
200 mesh, cream colored	$25.00@.....

(a) Nominal.

IRON AND STEEL

Pig Iron, Valley furnaces, gross ton:	
Bessemer	$24 50
Basic	$23 50
No. 2 Foundry	$24.00
Steel, base prices, Pittsburgh:	
Billets, gross ton	$37 00
Structural shapes, 100 lb.	$2.25
Bars, 100 lb.	$2.45

Monthly and Yearly

AVERAGE PRICES

SILVER AND STERLING EXCHANGE

	New York		London Spot		Sterling Exchange	
	1936	1937	1936	1937	1936	1937
January	47.250	44.913	20.250	20.734	496.115	490.670
February	44.750	44.750	19.796	20.083	499.908	489.307
March	44.750	45.130	19.663	20.677	496.952	488.412
April	44.892	.....	20.245	.....	494.139	.....
May	44.869	.....	20.248	.....	496.850	.....
June	44.750	.....	19.770	.....	501.817	.....
July	44.750	.....	19.590	.....	502.178	.....
August	44.750	.....	19.490	.....	502.519	.....
September	44.750	.....	19.579	.....	503.455	.....
October	44.750	.....	19.977	.....	489.755	.....
November	45.431	.....	21.050	.....	488.727	.....
December	45.352	.....	21.238	.....	490.670	.....
Year	45.087	.....	20.075	.....	496.924	.....

New York quotations for silver not eligible for sale to U. S. Government, cents per ounce troy, 999 fine. London, pence per ounce sterling silver 925 fine. Sterling exchange in cents.

COPPER

	F.O.B. Refinery, Electrolytic				London Spot			
	Domestic		Export		Standard		Electrolytic (a)	
	1936	1937	1936	1937	1936	1937	1936	1937
January	9.025	12.415	8.358	12.112	34.706	51.497	38.788	56.497
February	9.025	13.427	8.566	13.828	35.313	59.225	39.463	64.013
March	9.025	15.775	8.708	16.590	36.040	72.339	40.227	76.167
April	9.169	.....	8.849	.....	36.975	.....	41.131	.....
May	9.275	.....	8.819	.....	36.690	.....	40.839	.....
June	9.275	.....	8.790	.....	36.324	.....	40.357	.....
July	9.352	.....	8.993	.....	37.217	.....	41.228	.....
August	9.525	.....	9.297	.....	38.259	.....	42.375	.....
September	9.525	.....	9.523	.....	38.915	.....	43.267	.....
October	9.563	.....	9.669	.....	40.980	.....	45.295	.....
November	10.161	.....	10.349	.....	43.932	.....	48.467	.....
December	10.763	.....	10.835	.....	45.946	.....	50.364	.....
Year	9.474	.....	9.230	.....	38.441	.....	42.650	.....

New York quotations, cents per pound. London, pounds sterling per long ton. (a) Bid quotation.

LEAD

	New York		St. Louis		London			
	1936	1937	1936	1937	1936 Spot	1936 3 Mos.	1937 Spot	1937 3 Mos.
January	4.500	6.000	4.350	5.850	15.397	15.494	27.272	27.150
February	4.515	6.239	4.365	6.089	16.022	16.141	28.319	28.328
March	4.600	7.190	4.450	7.040	16.608	16.767	33.027	32.979
April	4.600	.....	4.450	.....	16.097	16.234	.....	.....
May	4.600	.....	4.450	.....	15.530	15.601	.....	.....
June	4.600	.....	4.450	.....	15.170	15.259	.....	.....
July	4.600	.....	4.450	.....	15.856	15.954	.....	.....
August	4.600	.....	4.450	.....	16.772	16.859	.....	.....
September	4.600	.....	4.450	.....	18.009	17.974	.....	.....
October	4.631	.....	4.488	.....	18.446	18.375	.....	.....
November	5.114	.....	4.964	.....	21.723	21.693	.....	.....
December	5.554	.....	5.406	.....	25.560	25.503	.....	.....
Year	4.710	.....	4.560	.....	17.599	17.655	.....	.....

New York and St. Louis quotations, cents per pound. London pounds sterling per long ton.

TIN

	Straits, New York		Standard, Spot, London	
	1936	1937	1936	1937
January	47.234	50.925	209.731	229.350
February	47.962	52.010	207.081	233.750
March	48.037	63.043	213.080	282,988
April	46.963	.....	209.313	.....
May	46.352	.....	202.429	.....
June	42.204	.....	183.167	.....
July	43.021	.....	185.957	.....
August	42.579	.....	183.731	.....
September	44.754	.....	194.676	.....
October	44.975	.....	201.193	.....
November	51.392	.....	230.869	.....
December	51.823	.....	232.108	.....
Year	46.441	.....	204,445	.....

New York quotations, cents per pound. London, pounds sterling per long ton.

ZINC

	St. Louis		London			
	1936	1937	1936 Spot	1936 3 Mos.	1937 Spot	1937 3 Mos.
January	4.848	5.847	14.488	14.719	21.153	21.281
February	4.859	6.465	15.125	15.391	25.122	25.322
March	4.900	7.381	15.983	16.190	33.188	33.405
April	4.900	.....	15.181	15.334	.....	.....
May	4.900	.....	14.536	14.777	.....	.....
June	4.880	.....	13.896	14.122	.....	.....
July	4.783	.....	13.579	13.826	.....	.....
August	4.800	.....	13.528	13.759	.....	.....
September	4.850	.....	13.906	14.159	.....	.....
October	4.850	.....	14.554	14.835	.....	.....
November	4.974	.....	16.301	16.554	.....	.....
December	5.273	.....	17.957	18.145	.....	.....
Year	4.901	.....	14.920	15.151	.....	.....

St. Louis quotations, cents per pound. London, pounds sterling per long ton

CADMIUM AND ALUMINUM

	Cadmium		Aluminum	
	1936	1937	1936	1937
January	105.000	90.000	20.000	19.500
February	105.000	90.000	20.000	19.500
March	105.000	101.667	20.000	20.000
April	105.000	.....	20.000	.....
May	105.000	.....	20.000	.....
June	105.000	.....	20.000	.....
July	93.462	.....	20.000	.....
August	90.000	.....	20.000	.....
September	90.000	.....	20.000	.....
October	90.000	.....	20.000	.....
November	90.000	.....	20.000	.....
December	90.000	.....	20.000	.....
Year	97.789	.....	20.000	.....

Aluminum in cents per pound, 99 per cent grade. Cadmium, cents per pound.

ANTIMONY, QUICKSILVER, AND PLATINUM

	Antimony (a) New York		Quicksilver (b) New York		Platinum (c) New York	
	1936	1937	1936	1937	1936	1937
January	12.736	14.130	76.769	90.250	36.885	50.400
February	12.967	14.563	77.000	91.000	35.000	64.364
March	13.072	16.375	77.000	91.778	34.115	58.000
April	12.673	.....	76.731	.....	32.846	.....
May	12.410	.....	74.940	.....	32.000	.....
June	11.707	.....	74.192	.....	36.346	.....
July	11.245	.....	73.423	.....	39.308	.....
August	11.125	.....	73.923	.....	49.577	.....
September	11.740	.....	85.280	.....	68.960	.....
October	12.058	.....	89.240	.....	54.074	.....
November	12.233	.....	90.250	.....	48.000	.....
December	12.918	.....	90.250	.....	48.000	.....
Year	12.240	.....	79.917	.....	42.926	.....

(a) Antimony quotations in cents per pound, for ordinary brands. (b) Quicksilver in dollars per flask of 76 lb. (c) Platinum in dollars per ounce troy.

PIG IRON

	Bessemer		Basic		No. 2 Foundry	
	1936	1937	1936	1937	1936	1937
January	20.00	21.50	19.00	20.50	19.50	21.00
February	20.00	21.50	19.00	20.50	19.50	21.00
March	20.00	24.20	19.00	23.20	19.50	23.70
April	20.00	.....	19.00	.....	19.50	.....
May	20.00	.....	19.00	.....	19.50	.....
June	20.00	.....	19.00	.....	19.50	.....
July	20.00	.....	19.00	.....	19.50	.....
August	20.00	.....	19.00	.....	19.50	.....
September	20.00	.....	19.00	.....	19.50	.....
October	20.00	.....	19.00	.....	19.50	....
November	20.23	.....	19.23	.....	19.73	....
December	21.00	.....	20.00	.....	20.50	....
Year	20.103	.....	19.103	.....	19.603	....

Iron in dollars per long ton. F. o. b. Mahoning and Shenango Valley furnaces